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ABSTRACT

"Scanator" (a modern, ecological psychophysics encompassing a cohesive set of theories and methods for the study of mental functions) provides the basis for a study of "competence," the capacity for making sense in complex situations. The paper develops a functional model that forms a theoretical expression of the phenomenon of leadership. The essential reasoning underlying this work is that organizing principles, and coordinating cooperation in particular, which are known at the biological level, can be transferred to the psychological level to make the phenomenon of leadership intelligible. The mental expression of competence, the holophor, can by means of Scanator, be described topologically as a cohesive set of stable attractors which encompass information in the form of ideas. It is the coordination of the holophors created through competence which forms the basis for understanding the concept of leadership. The coordination process (coordinating cooperation) is analyzed as an innovative searching process, which aims at establishing a stable state: the superholophor. A series of hypotheses are postulated concerning the functional nature of leadership. A small-scale empirical investigation of cooperation between two college students was undertaken. Prior to the commencement of their cooperation, the students were asked to describe their expectations of the cooperation, which they were subsequently similarly asked to describe. Results support the theory postulated--the expectation holophor of one student is embedded in the cooperation holophor of the other, and vice versa. Contains 23 references and 21 figures of data. (Author/RS)

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Abstract

Scanator provides the basis for this work. Scanator is a modern, ecological psychophysics encompassing a cohesive set of theories and methods for the study of mental functions. Within the framework of Scanator we can study *competence*, i.e. the capacity for making sense in complex situations. Scanator does not, however, include a functional model to explain how various forms of sense-making are co-operatively co-ordinated. This thesis develops such a model, which forms a theoretical expression of the phenomenon of leadership. The essential reasoning underlying this work with the theoretical modelling is the idea that organising principles, and co-ordinating co-operation in particular, which are known at the biological level, can be transformed invariably to the psychological level in such a way as to make the phenomenon of leadership intelligible. The basic theoretical work is thus aimed at transforming a biological frame of reference to a psychological one in such a way that a set of organising principles can be maintained through the transformation process. The primary organising principle which is transformed can be described as a information-guided self-writing/self-reading process. It is demonstrated that this natural principle at the psychological level has the paradigmatic form: (int(A)) a (ort(O)) representing an intentional (int) oriented (ort) coupling of activity (a) between an agent (A) and an objective (O). By means of the (AaO)-mechanism, i.e. production of natural language, mental systems make the unknown known, that is, make sense. This specific form of organisation is designated as competence. The mental expression of competence, the holophor, can by means of Scanator be described topologically as a cohesive set of stable attractors which encompass information in the form of ideas. And it is the co-ordination of the holophors created through competence which forms the basis for understanding the concept of leadership. The idea behind the concept of leadership is linked to the organising principle which implies that two auto-oscillating systems, when linked up, will function as one virtual system. The co-ordination process itself, i.e. co-ordinating co-operation, is analysed as an innovative searching process, which aims at establishing a stable state: the superholophor, which will satisfy both auto-oscillating systems, which are necessarily altered by the same process. On the basis of the theory created, a series of hypotheses are postulated concerning the functional nature of leadership. The concept of leadership, as established in the present work, differs from mainstream concepts of leadership by being grounded in theory and operational, and can thus serve as the frame of reference for experiments. To contextualise the concept of leadership, a small-scale empirical investigation of co-operation between two students is undertaken. Prior to the commencement of their co-operation, the two students were asked to describe their expectations of the co-operation, which they were subsequently similarly asked to describe. The empirical investigation supports the theory postulated, as it can be demonstrated that the expectation holophor of one student is embedded in the co-operation holophor of the other, and vice versa. A distinct overlap is produced, which is exactly what should occur in the event that the two mental systems have been embedded in a co-ordinating co-operation.

The objective of this thesis is to develop a functional concept of leadership within the framework of Scanator, a modern, ecological psychophysics, which encompasses a cohesive set of theories and methods for the study of mental functions. The concept of leadership will be developed essentially on the basis of Kugler and Turvey's (1987) analyses of the physics of psycho-biological movement, which in turn is based on an ecological understanding of information generation and information processing.

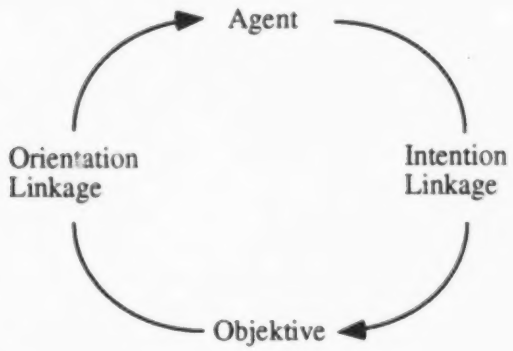
The body of thought which today supports modern ecological psychophysics traces its roots back to Gibson's analysis of the concept of information. According to J. J. Gibson (1979) the microscopic distributions of energy in the environment of a percipient system generate the macroscopic structural characteristics of that system. When, for example, ambient light is shone on surroundings which include a number of textural elements, a noticeable change in intensity is generated at the borders of individual elements, thus imposing a structure upon the ambient light. This structure creates an optic array which, together with the motion of the visual system in relation to textural elements, appears as an optical flow-field. According to Gibson the optical flow-field generates information, as the optic array maintains its form through transformations in time and/or space determined by, for example, the transporting of the object or the movement of the system in relation to the object. Information, which is specific in each event, thus disseminates events by expressing the concrete layout of the environment in a living system. The higher the structural resolution of the event, the more information the event contains. But despite the fact that in any given event there may exist many degrees of freedom of information, the number of degrees of freedom on the macroscopic scale is substantially lower than on the microscopic. The number of degrees of freedom is reduced by the generation of information, and it is this which is the function of information generation.

Several forms of information are, according to Gibson, invariant, in the sense that they must appear in an identical manner through a variety of events. This applies, for example, to the way in which geometrical forms move in relation to the visual system. If the visual system is, for example, moving towards a circle, which is perceived by the system to fill more and more of the optic array, the flow-field which this circle generates will change character in a regular manner. This regularity is identical for all movements of this type regardless of the character of the event, and thus regularity as information on movement in relation to textural elements is by nature invariant. Whether the textural element is a circle or an elephant thus makes no difference whatever. It is such invariance which make possible the movements of live organisms in unknown surroundings. The invariant global and local flow-field characteristics of its optic array inform the given system of its position, orientation and movement in the environment of the system. Regardless of their individual structure there are, for example, forms of optical flow-fields which invariably specify a chasm in such a manner that the movement of the system towards this same chasm can be halted in time (Gibson, E. J., & Walk, R. D., 1960). Gibson's concept of information does not, however, indicate how a system, which for example is nearing the edge of a chasm, actually does stop. It is thus possible that Gibson, with his concept of information, manages to point out how a system is informed in the literal sense, but his concept of information does not involve the system, as some sort of agent, putting the information into perspective and thus letting an intentional selection of information inform the agent. Gibson can point to information as being something which is causally generated in a *relation* between a system and its environment, but he fails to grasp the reality of information in the intentional *relationship* between an agent and its objective. As my colleague Niels Engelsted has pointed out, Gibson overlooks the fact that the environment of a system is not identical with an ecological system, which includes just this intentional relationship between agent and objective. The same problem exists in the theories advanced by Kugler and Turvey. Although the intentional component is a part of the theory because of the activity-component, the intentional agent is still inferential.

The present work takes as its point of departure Gibson's argumentation to the effect that a coherent set of *data* is generated in events, which implies that even if a certain activity is not in itself determined, event-specific data is nonetheless produced in a regular manner in this non-determined activity, which communicates the structure of the event. This causally generated set of data becomes information to the extent that the system is intentionally oriented in relation to this set, i.e. the moment that the system appears as an *agent* which posits objectives, where the concept of positing objectives includes intentionality as well as orientation. This specific ecological basic form can be described by means of the model shown in Figure 1:

Figure 1.

The Ecological Relationship between Agent and Objective



The model shown above sums up the basis of the three theoretical approaches which will be integrated in the present work. I shall later return to the internal dynamics of the model.

The first approach was developed by Kugler and Turvey (1987). Kugler and Turvey assume that biophysics (and, I wish to add, ecological psychophysics) is not a reduction of the biological and psychical to the physical, but an attempt to define a set of organising strategies, which is general enough to be applied irrespective of scales and disciplines within natural science, including psychology. In other words, that it relies upon work with scale-independent strategies. The reason for using this set of strategies as the foundation of the present work is the conviction that keeping to a strictly natural scientific work regime will produce results within the field of psychology which would otherwise be unobtainable.

It is, naturally, both obvious and correct that active living systems, thereby including mental processes, are not identical to, for example, point-masses in motion (Kugler & Turvey, 1987). They may share common organising strategies but the forms of regularity they exhibit will differ. Living systems differ, for example, from closed physical systems, in their characteristic of being open for energy and material flows. Opening a system for energy flows, which at the mentality level appear in the form of information flows, involves the generation of constraints which bind the internal degrees of freedom of the system. In reducing the internal degrees of freedom, new spatio-temporal structures arise, which are accompanied by new forms of activity. This means that open systems, in contrast to closed physical systems, cannot be fully determined by initial and boundary conditions. An autonomy exists which, as will be shown in the following discussion, is divided over different scales: micro and macro. It is in fact the relationship between the micro and macro scales which in the end describes the system's

activity, regardless of the point of view from which the micro and macro scales respectively are defined.

In the present work I intend to adopt Kugler and Turvey's micro-macro strategy, with a view to developing a modern psychophysical concept of leadership.

It is important to keep in mind that neither data nor information are discrete categories. Discrete categories cannot specify continuous activity because of the fact that they are discrete. It is thus inconceivable that language can, as for instance Chomsky (1966) maintains, in the form of pre-established general classificatory procedures or programmes, specify continuous activity. Natural language can, however, continuously assemble information generated and make sense from this information, as described by B. Bierschenk (1991, 1993a) and I. Bierschenk (1992a,b), and the manner in which the individual makes sense is just as regular as the manner in which information is generated. *Perspective Text Analysis,* the theoretically and empirically based method developed by Bierschenk and Bierschenk to reveal mental structures, serves as the second approach to the development and study of the concept of leadership here. Bierschenk and Bierschenk have demonstrated that the intentionally directed, non-determined text production is just as causal as the determined generation of information, where causality here means that nature, and thus also the psyche, are comprehensible in terms of regularity. The laws of the psyche in the form of sense-making can be revealed through text analysis.

The Discontinuity Theory (Elstrup Rasmussen, 1994a,b,c) is the third and final approach to the development of a concept of leadership. Within this theory the concept pair competence/qualification has been developed and proposed as the basis for understanding the concept pair leadership/administration. In Elstrup Rasmussen (1996) qualifications and competence are described as follows:

Definition: A qualified personal performance is an unfolding of knowledge, insight and values, which systematises an occurrence in such a way that a specific **goal** is achieved.

It is the qualification of an individual to be able to systematise ideas, which include knowledge and values, in such a way that the person concerned can maintain a high rate of repetition and thus reproduce him- or herself with a relatively high degree of certainty. It is further assumed that administration is a relationship of dominance under which one person's qualified systematising of an event creates the limits for another person's systematising of the same event.

The individual, however, knows how to, both alone and together with others, do more than just repeat, but to make sense of complex events. It is the function which ensures that this is possible that I call competence.

Definition: A competent personal performance is the expression of an assembling of ideas that perspectivises, orders and organises an occurrence in a sense-making way.

By virtue of their competence, human beings make the unknown known by making sense through the production of natural language. By, for example, talking his/her way through the unknown, the person calls forth new ideas, i.e. new knowledge and new values, which make the unknown sensible. According to the theory of discontinuity leadership is presumed to be an integrating relationship between various forms of sense-making. The discontinuity theory does not, however, include functional models of how different sorts of sense-making interact in the form of leadership, but against the background of a critical analysis of mainstream perceptions of leadership the idea has been developed (Elstrup Rasmussen, 1996), that leadership is a form of co-ordinating co-operation. Kugler and Turvey (1987) have developed a model for co-ordinating co-operation at the biophysical level, and it is the assumptions of this model as transformed to the psychophysical level with a view to the further development of a concept of leadership which serves as the theme of the following pages.

Physical Premises for Generation of Information

The natural scientific strategy which I am attempting to adopt here is basically connected to the claim of the constancy of energy (Kugler & Turvey, 1987). Energy may assume different forms but is constant *in toto*. This implies that the states which, for example, Newton's and Einstein's mechanics describe, can ideally be reduced to symmetrical expressions or equations, which are defined using potentials such as mass, momentum and energy.

Physics assumes that a heterogeneous division of potentials gives rise to forces which in turn create motion. A mechanical system is thus determined by the relationship between matter and a potential field. In Newtonian mechanics the potential field is regarded as being external forces which causally move matter, which does not itself include the means of introducing or absorbing these forces. Living systems, including psychical systems, distinguish themselves by being able to resist external minimum trajectories by themselves introducing potential fields. The trajectories of living systems are thus derived from the relationship between internal and external potential fields, which means that ecological systems are linked in a form of *circular causality*. This implies that it is not possible to take advantage of the trajectories of living systems to derive activity equations in the same manner as it is possible to put together physical equations of motion on the basis of observations of the movements of masses. The classic example of the difference between the description of living and non-living systems as trajectories in phase space is an experiment undertaken from the top of the Leaning Tower of Pisa. If a stone is thrown from the tower, as a mass it will follow a minimum trajectory towards the earth, but if a bird is thrown it will fly on its own course — but not just any random course.

Living systems are thus capable of more than mechanical ones, as they have the possibility by virtue of their own internal potentials to move in opposition to external minimum trajectories. It is further claimed (Kugler & Turvey, 1987) that the way in which living systems, including the psychical, move in relation to external trajectories is guided by information. It is thus maintained that as soon as the trajectory of a system is stable and reproducible in a field, where the trajectory is not the result of the field acting directly upon the system through a mass dimension, then the system is information-guided, where information as referred to above consists of macroscopic structures which are generated on a regular basis by microscopic fields in and through the system's *intentional* movements in relation to these fields.

Because the macroscopic structures are generated on a regular basis, they will specify the underlying layout of potential fields. Information is thus not merely an alternative, i.e. a more abstract description of or symbol of something else, as Frege (1985), for example, maintains but is in reality *in-formation* and it is this information, that the human being as a psychical being can, through language, operate with at the idea level, as ideas are described in Elstrup Rasmussen (1994b). This is to say that the individual being is not only guided by information but also processes information. Psychical systems are interesting exactly because they, as systems, are not required to follow external minimum energy trajectories, which implies that psychical systems can move towards whatever attracts them as long as they can mobilise the inner strength to do so. But mental systems are particularly interesting because they can deviate from their own *self-generated* minimum trajectories, in other words from the *systematism* which orients the qualified progression of the individual. Human beings can destroy their own stable qualification-determined activities, i.e. habits, and construct new ones. Humans can generate stable systematisms, as these are determined in Elstrup Rasmussen (1994b) and transform the same by creating meaning through the use of natural language as described by Bierschenk (1993b). Humans are not only information-guided but also information-processing.

Because humans as systems produce themselves to a great extent the basis for their own activity, the problem arises of how to discover what systems of measurement can be put to use in connection with determining the regularities of the system.

Extrinsic and Intrinsic Systems of Measurement

Systems of measurement which are defined independently of the events being measured are called extrinsic (Kugler & Turvey, 1987). The predefined measuring device means that statements on regularities belong to the given system of measurement and not the object being measured. Newton's mechanics is an example of this. The problem of using extrinsic systems of measurement is that they are, so to speak, foreign to what they are measuring, as the extrinsic systems of measurement have not been developed according to the premises of the system measured. In further expanding upon Newtonian mechanics, Einstein had to take issue with the idea of objectively existing extrinsic frameworks of reference by creating an intrinsic system of measurement with a natural measuring unit. He created an intrinsic measurement structure dictated by the characteristics of the system being measured. Einstein thus claims that matter and its motion at any point defines the geometrical character of the four-dimensional continuum of time and space. Matter creates the curved geometry of time-space, which moves matter. Matter and time-space are thus according to Einstein conjugated, which is to say that matter and time-space are mutually defining. It is not a question of two independent variables interacting but of a divided unity. If measurements are to be made in such a system, an arbitrary reference point must be chosen, for example, an individual mass, just as a unit of measurement must be developed which is determined by the system itself. We could say that in a conjugated system the motion of masses, for example, are measured within the frame of reference which these masses themselves have generated.

The lesson to be learned from this, and which has been learned from the discoveries of Einstein, is that the system of measurement, i.e. measuring structure and measuring unit, to be used should be defined on the basis of the subject matter to be investigated, regardless of the nature of the subject matter.

In behavioural science it is necessary to assume that the activity of a system and the frame of reference in which this activity is embedded, are conjugated. All modelling must thus apply a natural unit of measurement. But how do we find this?

Micro-Macro Systems and Thermodynamic Movements

Every system can be described at different levels (Kugler & Turvey, 1987). The ordinally higher level is called the macroscopic frame of reference, while the ordinally lower is called the microscopic frame of reference. If we observe a system of interacting atomic units, this interaction itself can be described. If we observe the same system, however, on a higher analytical scale, it can be described as a field. In other words, by changing the scale of measurement it is possible to catch sight of different characteristics of the system. In general, the ordinally lower scale of analysis can be expected to provide the frame of reference for the occurrences which take place at the next ordinally higher scale.

Systems which include many interacting particles, i.e. systems with large numbers of degrees of freedom, can be dealt with through a set of methods: thermodynamics, statistical mechanics and kinetic theory, which all fundamentally are concerned with energy transformation. What is interesting about *thermodynamics* as a method is, however, that it is *independent* of any form of theory of matter or interaction mechanisms. Thermodynamics is only interested in whether the processes it monitors maintain time-space symmetries, i.e. whether they maintain the possibilities of identity transformations, or whether they destroy the time-space symmetries. Thermodynamics thus concerns two forms of processes: reversibility, which maintains a system's equilibrium, where equilibrium is defined as homogeneous energy distributions in time and space relative to the boundary conditions, and irreversibility, which destroys a system's equilibrium relative to the boundary conditions. The latter type of process takes two forms: a thermodynamic assembling of constraints, i.e. neg-entropy, which creates structure and thermodynamic dissolving of constraints, i.e. entropy, which destroys structure. The

assembling of constraints normally is part of systems which are open to energy flows, as closed systems can only coincidentally move towards higher degrees of structure.

For the same reasons, work within thermodynamics involves two concepts of time. The first is linked to reversibility, which implies that the energy of a system can change form, e.g. from potential energy to kinetic energy, and back again without in so doing disrupting the constraints which determine the structure of the frame of reference. The trajectories, which describe the system in phase space are symmetrical both in time and in space. Within the irreversible area the disruption of constraints, on the other hand, plays an active role in the definition of time, which in principle is aimed at a reduction in the number of constraints, i.e. at a decrease in structure. But constraints can also be formed aimed at increasing structure. The dissolving and assembling of constraints, which is thus identical with changes in the configuration of the frame of reference, is inseparably bound to the temporally directed irreversible flows (Prigogine & Stengers, 1993).

Should an accumulation of potentials occur, for one reason or another, in a local area with the result that the symmetry of a field is disrupted, it will set off an irreversible flow. A difference in potential can be described quite abstractly as a relationship between the large potential, which is called a source, and the smaller one, which is called a sink (Kugler & Turvey, 1987). When a source is connected to a sink a flow starts. This flow or transport process defines the context between a field's atomisms and characteristics of the field's configuration, i.e. its difference in potential. If differences in potential exist, the atomisms are set in motion by these differences in potential in such a way that the constraints which the differences in potential constitute are dissolved, whereby the frame of reference moves towards less structure.

Within thermodynamics the mimima of the potential function is by nature defined relative to local boundary conditions and it is important to keep the idea of boundary conditions in mind, since it is just these conditions which can maintain the stable configuration of an open system. Whereas conservative systems, i.e. closed systems, move in the direction of *equilibrium* in relation to their boundary conditions, non-conservative, i.e. flow-through systems, move in the direction of *stability* and this is the irreversible, temporal source-sink process which is monitored by thermodynamics. In Figure 2 an attempt is made to illustrate this.

If we observe a flow, we have two conjoined parameters with which to describe it. The first is the concentration gradient, i.e. the difference in potential which is associated with the driving force, and the second the flux, i.e. the amount of material which is transported per unit of time.

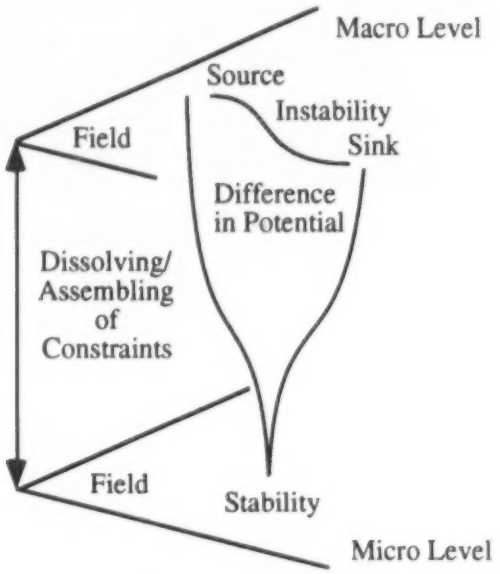
By observing variations in the flow, we can identify the minima for the potential function, which generate the forces driving the flow, regardless of the type of flow involved. If it is possible to identify a variation in flux in a medium, then it is also possible to derive the potential function providing the force to transport the material. In other words, any and every flux exhibits a source-sink function, which is moving towards stability. Just what the force moves is of no importance. Thermodynamics is *not* ontologically specific, which is an important aspect of ecological psychology. Since thermodynamics is only a method of monitoring flows, it can be used wherever they occur. It is, for instance, this unique characteristic of thermodynamics which has enabled B. Bierschenk (1991, 1993b) and I. Bierschenk (1992a,b) to model the underlying dynamics of natural language. Bierschenk & Bierschenk show, for example, how a text flows in the form of graphemes. In this flow the flux is determined as the number of graphemes per natural unit of time, as formed by the pauses which occur in the text and are given symbolic form, for instance, through the use of punctuation marks. By determining the flux we obtain an indication of the structure which, through idea-determined words, collects information. Thermodynamics, however, as a method of monitoring reversible and ascending and descending irreversible processes, does not include the clock function which is necessary, for example, for the rhythmical development of natural language and accordingly the human psyche. In other words some general models

need to be developed which can serve on a thermodynamic basis as a frame of reference for the understanding of the specifically human cyclical forms of expression and development, whose cyclicality points to the natural measurement unit for the system.

The point of departure for developing such models is the "natural engine", the prototypical form of which is Brownian movement.

Figure 2.

An Illustration of Thermodynamic Processes in the Form of the Dissolving and Assembling of Constraints.



Physical, Biological and Psychical Engines

If we observe a system which includes macro and micro particles we notice that, as long as the ratio between the particles is of a certain magnitude, the macro particles move in small spurts in random directions, a motion also known as random walk (Kugler & Turvey, 1987). The reason for this is that the macro particles are pushed around by micro particles through the dimension of mass. Brownian movement comprises a limiting case in physics; it is the prototype for all cyclical engines, where an ingine is a set of constraints which systematically convert various forms of energy into work.

The Brownian system includes a large number of micro particles, which incessantly collide with the macro particles. If the number of micro particles which collides with one side of a specific macro particle is larger than the number which is momentarily colliding with the opposite side of the particle, the macro particle will perform a small jump in the direction from which it is receiving pressure from the least number of particles. It is thus a question of the collective force of many micro particles competing with the collective force of a few micro particles. In the Brownian system thermal energy (the movements of micro particles) is converted to mechanical energy (macro particle movements) through constraints which are provided by the macro particle surface. The motor cycle can be described as a limit-cycle, which consists of the assembling of a potential, determined by fluctuation, which in the form of force is transformed to mechanical work, where the same mechanical work is transformed to the movements which can originate potentials. The only factor determining the behaviour of the system is the size of the particles and the fluctuations in the "energy reservoir".

In the closed Brownian system a continuous recycling of momentum occurs, from micro to macro via fluctuation and from macro to micro via dissipation, as a result of which the Brownian system can also only serve as the point of departure for a generalised model.

In physics any form of interaction is regarded as a collision, regardless of whether the interacting systems touch one another or interact only at a distance. (Kugler & Turvey, 1987). When objects collide one induces a dynamism into the other. The basic question in any collision is, through which properties the objects involved interact. In Brownian movement micro particles and macro particles interact through kinetic properties, i.e. in such a way that this includes a mass dimension in the form of force-linking. It is, however, inconceivable that the methodology which is to be applied to the investigation of the interaction of psychical systems with their environment, can include a mass dimension. Psychic systems do not physically collide with their environments. Thus a strategy needs to be developed, which does not include a mass dimension but which, nevertheless, can encompass this on another scale. In other words, a strategy aimed at developing an understanding which includes kinematic descriptions, which in an informational sense are causally dependent upon kinetic descriptions. The proto-example of information determined interaction is, according to Kugler and Turvey (1987), the nest-building behaviour of termites, which as a biological engine is characterised by a microstructure in the form of chemical fields inducing a dynamic in the macro entities, i.e. the termites, and where the macro entities for their part induce a dynamic into the microstructure, just as was the case in the Brownian system. In the case of the termites, however, it is not a question of a mass-based interaction.

The nest-building behaviour of termites is simple: as a termite flies around it intentionally, but haphazardly, collects and drops nest building material containing a chemical substance. Where the material lands a potential is created with the resulting gradient, which opens the way for a flow field, as in time the chemical substance spreads to the surrounding area just as rings spread in water. This relationship is illustrated in Figure 3. At the top the potential function is pictured as a source-sink relationship, which includes irreversible processes, the result of which are reversible processes. At the bottom the same potential function is pictured as a flow field.

If the same or another termite enters the flow field it sets its course intentionally *against* the gradient and drops its own nest-building material in the spot where the gradient originates. This origin can, in phase space, be described as a topological singularity, i.e. as an attractor point. The established attractor, which is a flow-field abstraction, informs other termites, who themselves drop material in such a way as to gradually form a pillar through the repetition. The temporally dependent, dissipative configuration induces as a microstructure a dynamic in the macrostructure, i.e. the insects, in the direction of a preferential location, which through cyclical deposits of material form a robust and temporally independent structure, in this case the nest. This temporally independent structure limits the potentially infinite number of trajectories the insects can realise or: The topological qualities, which are the abstracted form of the kinematic flow field, appear as informational constraints, which limit, i.e. categorise, the system trajectories pursued by the insect.

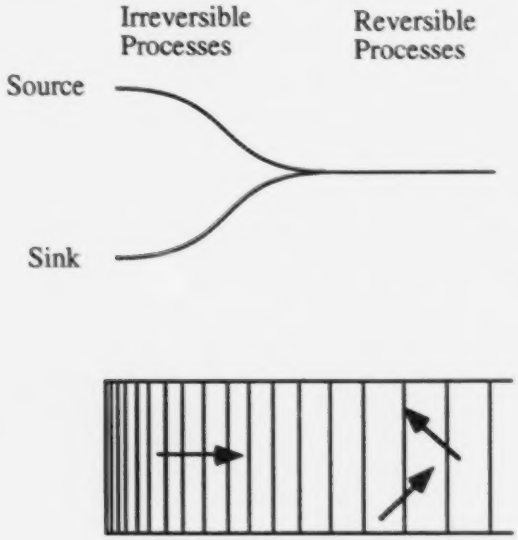
As long as a new concentration of substance is deposited within the radius of effect a concentration of substance, i.e. a pillar, has a new flow-field will arise between the two concentrations which specifies a virtual kinetic quality, that of the still non-existent contact between the two pillars. This virtual quality can be described topologically as a saddle point, which thus exists by virtue of the two previously established topological singularities. In this manner a new singularity is established, relative to the original singularities. The new singularity marks the finalisation of a period which has left behind a robust structure, namely an arc, which integrates the two pillars and which can form the point of departure for a new cycle.

What is interesting in this entire process is that the insects both create and are limited by the geometrical characteristics of the flow-fields. In this respect the developing

nest is an example of a rhythmical self-reading/self-writing system. The system reads and writes itself in circular causality, which follows the form force-field/flow-field/force-field, etc. and which can alternatively be described as activity-perception-activity, etc.

Figure 3.

The Potential Function Depicted as a Source-Sink Relationship and as a Flow Field.



Flow Field

As a theoretical model nest building is congruent to the Brownian system, which is a prototype of a cyclical movement where it is the micro field that limits macro movements (Kugler & Turvey, 1987). The Brownian system can be described in phase space as a limit cycle which is controlled by a fluctuation-determined assembling of a potential, which is transformed to mechanical work, where the same mechanical work is transformed to motion which can give rise to potentials. In the Brownian system it is kinetic qualities which link macro motion to micro fields, while in the nest building it is the kinematic qualities of the flow field which link the insects' macro movements to the micro structure of the flow-field. Nest building is a self-assembling information system, where the organisation occurs through a causal linking of an entropic micro structure and a neg-entropic macro structure. That this is a case of causality is evident in the fact that the process is *repeatable* in a predictable manner. That the process is repeatable in a predictable manner does not, however, mean that it is externally measurable in the Newtonian sense, since micro structure and macro process are conjugated. Any interaction which occurs through kinematic qualities, such as for example those possessed by flow-fields, is called informational. In the informational interaction causality is bound up with the formation of the information itself or the data which forms the basis of the information, and not with the interaction as such. It is thus important to keep in mind that information does not cause activity, but merely limits activity. Information is a constraint on activity, but this constraint is causally generated (Kugler & Turvey, 1987).

This understanding comprises the direct link with Scanator, which encompasses both the Discontinuity Theory as well as Perspective Text Analysis.

In the Discontinuity Theory (Elstrup Rasmussen, 1994b) it is argued that the basis for the formation of mental structures can be found in the active relationship between an

agent and this agent's objective, which can basically be described as differences, i.e. potentials. This relationship can be formally expressed as (AaO), where the assumption is made that the agent posits, i.e. both discovers and realises, differences. It is thus claimed that the agent stands in a double relationship to differences, where differences can be described in thermodynamic terms as potentials, which in the activity assume the form of information. However, in the same article the argument is advanced that the positing relation between agent and objective within the space comprised by a human life can only be comprehended self-referentially. Self-reference can be functionally modelled according to the form (Aa(AaO)), which implies that the agent in fact posits the positing relationship between agent and objective, which in turn means that the agent appears not only as information but as information processor. It could also be said that the self-reading/self-writing system which is comprised by (AaO) is doubled in the functional (Aa(AaO)) form of the self-reference.

This thinking is anchored in the schema model which B. Bierschenk (1984) has developed on the basis of Kant (1972). The schema model: (int(A)) a (ort(O)) expresses in the form of language that the agent (A) as a macro structure is actively (a), intentionally (int) oriented (ort) in its conjugated relationship with the objective (O), which comprises the micro structure. The model, which is presented graphically in Figure 1, describes a comprehensive self-writing/self-reading process, i.e. a limit-cyclical organising form of higher order.

Within the *self-reference*, which as mentioned can be described functionally as (Aa(AaO)), the objective (AaO) in itself is a self-writing/self-reading process, but of lower order. Since there is an information-driven cycle embedded in the self-reference, it can thus not be the information which limits the self-referring agent, but must be the geometries which the flow of information as potential functions gives rise to. These geometries, which must be at least one dimension larger than the information itself, I call ideas (Elstrup Rasmussen, 1994b). Ideas are thus a type of second-order information. Whereas the concept of information is tied to direct perception, the concept of idea is tied to information processing. Information could be said to be an abstraction of the complex ecology, while ideas are abstractions of the complexity which ecology itself produces as information flows.

> We can attempt to approach what complexity is - generally speaking. A crystal is not complex, it is completely regular in structure. A gas, on the other hand, is completely unstructured, but should not be called complex as a result of this. Complexity rests somewhere between order and chaos, there must be order in chaos.....
>
> Attempts have been made to define the level of difficulty of constructing or describing a system as a measure of organisational complexity. It is, for example, easy to describe the construction of a crystal — merely specify a single cell and the remainder is merely copies of this. For a gas it is sufficient to indicate the number of molecules in the container; we regard the individual positions of the molecules as random; there is no meaning or organisation in their positions. We see that the definition of complexity is dependent upon the meaning we accord to the details of the system, i.e. the measure of complexity implies a certain degree of relativity and subjectivity. [Thodberg, 1989, p. 3]

Self-reference thus includes information flows, which as potential functions give rise to ideas, which as the micro structure of the object limit the agent as the ideal macro process.

Within the framework of this thought it is shown (Elstrup Rasmussen, 1994b) that the individual human, as a self-referential limit-cycle system, can construct mental structures which, in the form of ideas, include knowledge, insight and values. In the same way as the termites as a system are in a position to create temporally independent,

stable structures, in the form of pillars, which involve *identical* material forms, and arcs, which *integrate* pillars, the person is in a position to *identify* and *integrate* ideas to systematisms, which are stable mental forms that thus include knowledge, insight and values. The prototypical ideas comprise in their entirety a form of objective systematism, which limits the agent in the form of qualification.

In the same manner as the external, temporally independent, pillars and arc structure in the form of the nest determines the behaviour of the termites the internal systematism determines human activity in the form of a repertory of qualifications which is characterised by repeatability. What is unique about human consciousness as opposed to, for example, termites is that it includes the "internal" (int(A)) a (ort(O)) mechanism and that this mechanism can operate with absent objectives, where the absence makes possible the value form of ideas, as described in Elstrup Rasmussen (1994b). To each idea, which includes knowledge and insight, a value is tied pointing to the quantity which is connected with the absence of the objectives which exist in the form of ideas.

In the Discontinuity Theory (Elstrup Rasmussen, 1994b) it is shown that the production of identifying knowledge and integrative insight can be topologically described as a fourth-order catastrophe, as this is described by Thom (1975). This means that the formation of ideas can be described as attractors, which as systematisms can be described morphologically as attractor fields. I shall return later to the description of attractors.

Even though the generalised model captures the causality which is inherent in any information- or idea-driven system, the model does not, however, describe the trajectory of such a system in phase-space, i.e. the system's form of development. The additional proposal is now made that information- and idea-driven systems not only develop but also progress cyclically, or: that mental systems involve a clock mechanism which segments and thereby structures the self-reading/self-writing process over time (Bierschenk, 1996).

Rhythmical Systems

The free and self-swinging pendulum is the prototype for auto-oscillating systems. All auto-oscillating systems include oscillating components, like the balance wheel in a clockwork, defined by its mass and length, an energy source, an escape mechanism which makes energy accessible for the system in suitable packages, and a linking component which controls the escape mechanism (Kugler & Turvey, 1987). The ability of the pendulum to swing steadily is due to the escape mechanism tied to it, which through a phase-independent linking sends one energy package into the system each time it has completed a swing. The clockwork is the classic example of a hard-moulded oscillating system. It is characteristic of the hard-moulded oscillating system that the amount of energy injected is independent of the phase. The length of the pendulum alone determines the phases and the design of the escape mechanism the amount of energy added to the system and the two parameters are not internally connected. This means that to change the movements of a hard-moulded oscillating system requires an external instruction.

This is not the case for soft-moulded oscillating systems. In such as system the period must be able to change without external instruction. A horse must, for example, be able to go from a walk to a trot without external instruction, i.e. the shift must be brought about by the system itself. For a shift to occur, for example, in the oscillation period of a soft-moulded system with fixed oscillation components, it is the energy added which must be altered and this means tuning the escape mechanism. Since in the present models there is to be no recourse to any hidden intelligence, a homunculus, to give instruction, the escape mechanism's energy modes thus have to be provided by the cohesion in the system itself. The escape mechanism must be able to be altered as a result of its inherent regularities and not by system-external rules. There must quite simply exist a regular linking of frequency and energy, which is arranged in such a manner that the moment it becomes necessary for the rhythmical movement to assume an alternative state,

the energy which is needed for assembling and maintaining that alternative state will be specified. In other words, a mutual internal dependency must exist between that which could be called the operational components and the energy which the escape mechanism admits. Or the energy flow must make possible the assembling of (altered) configurations which can dissipate the increased energy.

The thinking which supports the above has been developed by Prigogine (Prigogine & Stengers, 1985), who makes use of the concept of dissipative structure to deal with the phenomenon by which an energy field, through a field of loosely linked operational components, can give rise to the occurrence of a set of soft-moulded constraints, which temporarily organises the field. Prigogine has shown that in areas which are far from equilibrium, strong processes can arise which generate instabilities that can increase the organisation of the field. This can be shown, for example, by the patterns formed on the surface of a Bénard cell which cannot be explained by the forces which exist between the liquid particles. A Bénard cell is a small liquid-filled container through which energy flows. When the energy flow becomes sufficiently great the structures mentioned can appear. As described in phase-space (Kugler & Turvey, 1987), the dissipative geometry is evident in the appearance of certain qualities which can orient the trajectory of the system. The appearance of orienting characteristics such as point attractors, limit cycles, and strange attractors, indicates the transformation from fields without preferential positions to fields with preferential positions. The dissipative geometries which emerge when two or more fields compete, describe situations which satisfy the flow problems for all the competing processes.

The premises for the occurrence of the dissipative structures is the existence of a reservoir of potential energy, from which a work cycle can begin, and that the operational components have more than one degree of freedom. As long as these premises exist, a competition can arise between the energy flow and the ability of the operational components to absorb the energy flow in their present configuration. The relationship between the degrees of freedom of the operational components and the dissipation can be exemplified by a falling leaf (Kugler & Turvey, 1987). When a leaf falls the energy produced by the relationship between the forces of gravity and air resistance flows through it. At the beginning of its fall the leaf trembles. In trembling the leaf rids itself of the energy. When it is no longer sufficient to tremble, the leaf begins to rock back and forth, and finally to spin, after which the leaf has no more degrees of freedom available to it. Through the three stages of the fall degrees of freedom, inherent in the structure of the leaf, are activated one by one. These three degrees of freedom are thus the sink modes through which source energy is dissipated. Each new sink mode is actualised through an interaction between macroscopic degrees of freedom and microscopic dissipative processes and the implication is that in the evolutionary process steadily more effective macroscopic dissipative structures are developed.

The falling leaf exemplifies the characteristics of dissipative structures (Kugler & Turvey, 1987): (1) a reservoir of potential is available, (2) several possible degrees of freedom exist in the operational components, (3) competition arises between the amount of potential energy which flows into the operational components and the ability of those components to dissipate energy, and (4) a critical amount of energy flows into the present structure of the operational components, so that new degrees of freedom are actualised or made necessary in order to be able to absorb the flow of energy. The new spatio-temporal regimen, i.e. self-organisation, comes into being as a function of competition between the energy flow into a field and the ability of the operational components to dissipate that energy. If the required degrees of freedom *are* present, the dissipation of energy can be actualised through a set of configurations. If the energy flow *exceeds* the amount of energy that the operational components can dissipate, the excess energy can be used as a source of energy for reorganising the operational components in a new organisation which can dissipate a larger amount of energy. The emergence of new configurations, as a function of dissipative energy flows through sets of operational components, identifies a natural order.

Within Scanator this natural order exists as a relationship between competence-creating sense and the unfolding of qualifications determined by systematisms.

As mentioned previously, the individual person as a self-referential, i.e. auto-oscillating, system includes a systematism, which is in fact a set of idea configurations that, in the form of qualifications, can dissipate information flows. Or, to put it another way, a qualified agent intentionally actualises the idea configuration, i.e. the systematism, which can dissipate just that degree of complexity which the flow of information gives rise to. The more complex the flow of information is, the greater the number of degrees of freedom, i.e. ideas, the idea configuration will include which orient the unfolding of qualification. The unfolding of qualification is understood rhythmically in such a way that the unfolding of qualification functions in relation to the information flow as the escape mechanism which segments the flow of information through systematisms. These in turn orient the qualification that intentionally links to the systematism which can dissipate the complexity the flow of information gives rise to, or: known variations in the flow of information actualise different sets of ideas, with the result that the individual person acts according to his habit under known conditions.

Here it is important to keep in mind that the systematism of the individual human, i.e. that person's set of idea configurations with the accordant unfolding of qualifications, is tied to concrete events in the form of information flows. Agent qualifications and objective systematisms are not something which the individual human possesses in the form of abstract classes, which can be unfolded as procedures through rules. The qualification-systematism cycle is a functionality which unfolds with the flow of information and which changes character by means of this flow, as the flow of ideas continuously actualises different configurations of ideas. Such idea configurations can be described as preferred situations in phase-space, i.e. as attractor-determined morphologies which orient the intentionality in the flow of information. What is interesting about human systems is, however, that they themselves, through self-reference, take part in producing the flow of information and thus the complexity that they as systems intentionally orientate themselves in. It is this phenomenon which appears as the reasoning which, under quite special circumstances, can be presented in the form of formal logic. Humans thus do not think in the form of calculations but their reasoning, which in essence is comprised of sequential functionality-ordered limit cycles, can be organised calculatorally.

When a given information flow gives rise to a complexity exceeding the limits set by the functionality of a system, or in other words the sequential qualification-systematism cycles of the system, this information flow forces the agent to intentionally reconfigure the orienting systematisms. To be able to handle a complexity which exceeds the limits of the existing idea configurations, the system must create new and previously unknown idea configurations. Or the system is forced to act innovatively, i.e. to create new dissipative structures.

If a system, on the basis of the growing complexity of the flow of information, is pressured to go beyond its limits, i.e. its systematism and thereby its qualifications, the systematisms disintegrate, and in so doing the system components, i.e. the ideas, are set free. These freed ideas appear as a reservoir, in which the (int(A)) a (ort(O)) mechanism functions as a creator of the natural language that, through ideas in the form of words and pauses, which are the (int(A)) a (ort(O)) mechanism's clock function, reconfigures the systematisms into the sense which through *repetition* becomes new forms of systematisms which can dissipate complex but known information flows. The language mechanism (int(A)) a (ort(O)) functions quite simply as a natural clock, which can dissipate the complexity created by information through the creation, in a rhythmical manner, of alternative idea configurations which pick up the information which has forced this very reconfiguration. The innovatively created, dissipative idea configurations, which are event-specific and which specify the event, are called *sense* as was previously stated (Elstrup Rasmussen, 1996). Sense is the intentionally determined form of objective which through orienting limits competence, which is the agent form that determines sense

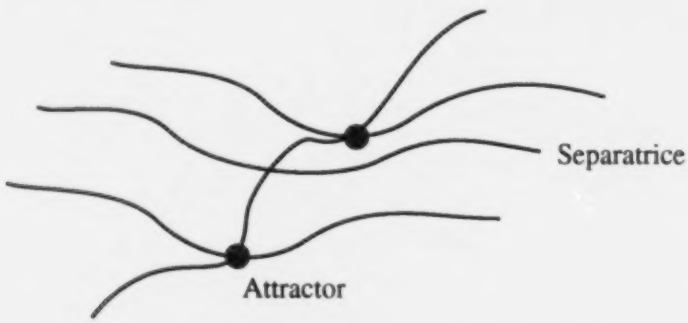
intentionally. Competence is an irreversible, sense-making process which in the form of *repetition* appears as the unfolding of qualification determined by systematisms. Sense can be described morphologically as a holophor (Elstrup Rasmussen, 1996), the base of which is an attractor field.

The Attractor Field as the Basis for Describing the Holophor

The point of departure for understanding the holophor as an attractor field is naturally the flow of information. The flow of information has some field qualities which in phase-space can be described as attractors and separatrices (Kugler & Turvey, 1987). A flow-field is comprised quantitatively of the number of vectors in a state space. Regarded in a qualitative sense the flow-field can decompose into a number of open sets, which define basins, each of which contains a singular state called an attractor. In the flow of information this corresponds to having many pieces of information so to say pointing in the same direction, namely towards a specific idea. When the previously mentioned language mechanism functions, it parses the flow of information, with the help of linguistic agents, so that constraints are assembled which pack the information, so to speak, in such a way that it points towards a specific and summarising idea. When natural language is spoken or transformed to text through writing, the language mechanism's natural clock parses the flow of information and in so doing — if we use the phase-space description — a row of information basins are assembled which are divided by separatrices, where a separatrice is the line which divides two basins. An attractor portrait can be compared to a map, upon which altitude contours have been drawn to indicate low-lying areas of the terrain. The attractor is the bottom of a depression, as shown in Figure 4. If we were, for example, to release a ball on the side of the depression, it would move towards the bottom. A comprehensive description of actual basins and separatrices comprises an attractor portrait of the flow-field, as it is parsed by the language mechanism. The attractor portrait describes the preferential states of a system at a given time.

Figure 4.

A Section of an Attractor Portrait



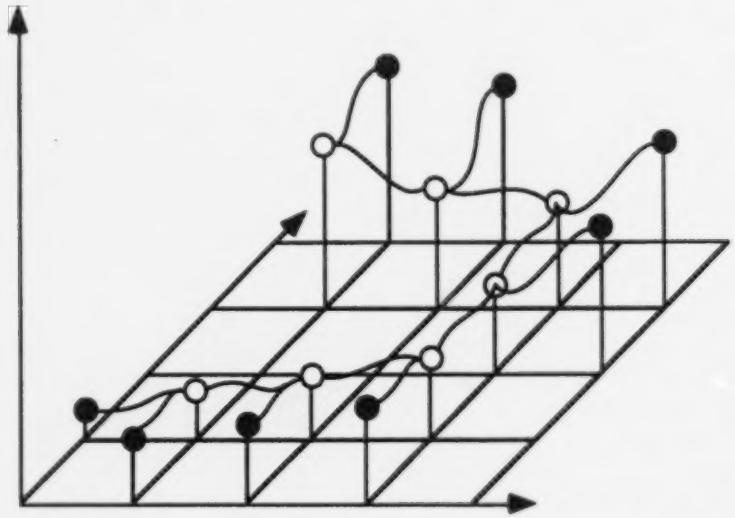
An attractor portrait, however, is not identical to a holophor. The holophor, which expresses sense, is a second-order representation of the attractor portrait or, in other words, the preferential states of the attractor portrait, i.e. the basins, are interrelated as differences in potential, which as source/sink relations provide the opportunity for the portrait's inner stable states. The above can be illustrated as shown in Figure 5.

The black dots in Figure 5 illustrate the singularities which indicate the preferential states of the attractor portrait. In the three-dimensional phase-space the attractors, i.e. the basins, are situated at various levels. They have varying values and as a result the attractor portrait presents differences in potential. As source/sink relations, these differ-

ences in potential provide the opportunity for the internally mediating stable states which are indicated as white dots. It is this entire three-dimensional description in phase-space which is designated as a holophor.

Figure 5.

The Holophor as Second-order Representation of an Attractor Portrait



As long as the entire holophor or parts of it are repeated in similar events it becomes a part of the objective systematism which orients the intentional agent qualification. The systematism is structurally stable when its topologically defined form remains essentially unaltered through small perturbations of the underlying vector field which describes the movements of the system. This is to say that the system can act, so to speak, in the same manner despite minor alternations in the flow of information. The flow of information is simply treated as if it were identical with flows of information in which the system has previously been.

It is important that the agent can be intentionally oriented in relation to the stable tendencies in the given systematism and that the agent can mobilise intentional forces of such magnitude that it can both resist as well as go along with its self-generated forces, and thus actively move towards or away from limit cycles. To be qualified thus includes the ego-strength to do what one can do and competence includes the ego-strength to depart from prescribed systematisms and create new sense, even in known situations. The stable state in which the system comes to rest is both produced and discovered in the course of the rhythmical movement.

It must be kept in mind that the energy to commence and maintain temporally dependent stable states originates in the system itself. The energy which is needed to achieve a stable state is not provided in advance but rather is created in the process itself, just as the forces which must keep the system stable evolve in time through the event-specific information flow.

How, then, is this stable state reached? How does the system itself discover the preferential state? The hypothesis is that the idea which is specific for the preferential stable state appears as an abstracted geometric description of the flow of information. A situation exists which, for the given information flow, involves a minimum of cost, despite the fact that in principle other situations could be selected. Presumably it is the

value measure of the idea which sets the measure for the costs involved in selecting a specific set of attractors that at the same time determine the value measure that stops the holophor and thereby the activity. The basis for the stop mechanism is thus that microscopic, high-dimensional information-flow characteristics can be compressed into macroscopic, low-dimensional characterisations in the form of holophors which control the activity. Activity control is low-dimensional despite the high-dimensional complexity which is found at lower levels. The final idea is the internal macroscopic unit of measure which corresponds to the final stable state. The final idea is thus the macroscopic unit of measure by which the stable state can be evaluated and thereby concluded by being maintained until other sorts of information flows make transformations necessary. That which is macroscopically observable is created in the rhythmical activity that language development is. But since the preferential stable state can be discovered, the stable state must exist, in one sense or another, continuously through the rhythmical movements even through those which are not precisely identical with the preferential state, but lead towards it, so to speak. The internal trajectory of the holophor is thus mediating stable states, which lead on towards the final situation, the value of which is the least costly of the possible stable states which are generated in a given event.

When ego-strength is mobilised and sense is created, the system appears as a decision. We make decisions, in fact, when we do not know what we should do. If we have the requisite insight there is no reason to take decisions. The making of decisions is not at all the same as making a choice. Leaders make decisions, for example, i.e. create a path, administrators make choices, which are preferences on the basis of pre-defined measures. I shall return to ego-strength, leadership and administration later. But first it is necessary to be able to model the way in which sense can be involved in co-ordinated co-operation. In order for one to be able to go in front and lead, there must be at least two people proceeding together, not just in the vicinity of one another. The idea behind co-ordinating co-operation originates in the question of how a double, cyclical system can function as a single virtual system.

Co-ordinating co-operation

The concepts of co-ordination and co-operation comprise the foundation for understanding the phenomenon leadership. In leadership two or more forms of competence must co-operate in a co-ordinated manner, so that tasks can be made sensible and thereby completed. The point of departure for a more detailed definition of the concepts of co-ordination and co-operation are the concepts identification and integration. In Elstrup Rasmussen (1994b) it was assumed that, as previously mentioned, identification, which posits as equal two or more similar ideas in a new category, and integration, which links up two or more ideas to a new idea, are two fundamental developmental forms which exist both within the individual self-reference and in the social network. The concept of co-ordination is used here to designate the identification of forms of sense making which appear as working together, while co-operation indicates the integration of forms of sense making which appear as that working together which produces an effect. Co-ordination, which is a higher-order identification, is thus a prerequisite for co-operation, which is a higher-order integration.

In Elstrup Rasmussen (1994b) it is however also assumed that a third and final developmental form exists, that of perspectivisation.

Perspectivisation is the developmental form which is linguistically manifest through prepositions. B. Bierschenk (1991) and I. Bierschenk (1989) have shown that the language mechanism earlier referred to, (int(A)) a (ort(O)), produces text which in its simplest form is a simple (AaO) statement such as: "The farmer splits the firewood on the block with an axe for the winter". Such a statement can be formalised as follows:

(A) The farmer
(a) splits
(O_F) the firewood
(O_G) on the block
(O_M) with an axe
(O_{G*}) for the winter

When the language mechanism functions perspectivisation splits the object with the help of prepositions in such a way that the objective appears in four different categories: *Figure objective* (O_F), *ground objective* (O_G), *means objective* (O_M) and *goal objective* (O_{G*}). In other words, perspectivisation functions as the boundary condition which structures the objective. As a boundary condition perspectivisation categorises the progression of the text and thereby the making of sense. Sense-making as a holophor therefore appears in four forms: figure, ground, means and goal.

The question now is how the three developmental forms, co-ordination, co-operation and perspectivisation can be conceived of in combination to form a functional leadership model.

The point of departure for leadership is a minimum of two independent, auto-oscillating sense-making systems. These auto-oscillating systems must swing together in such a fashion that we can speak of a single functional system.

From the classical model of linked pendula Kugler and Turvey (1987) have developed a universal model for virtual unit systems. The point of departure for the model is the depiction of co-operation as a situation which is maintained from below through an entirety of interacting atomisms and from above through boundary conditions. Every auto-oscillating system is organised in this way. In the present context the making of sense, i.e. the holophor, is the co-ordinating state which is created in the relationship between the co-operating atomistic ideas and the perspectivising boundary condition. The dynamic relationship, which is the (int(A)) a (ort(O)) mechanism between the lower idea level and the upper perspective level, creates the holophor in the individual auto-oscillating system. When two auto-oscillating systems are combined the co-ordinating structure is created which enables higher-order co-operation, which naturally results in the individual systems losing degrees of freedom. The model for co-ordinating co-operation appears as shown in Figure 6.

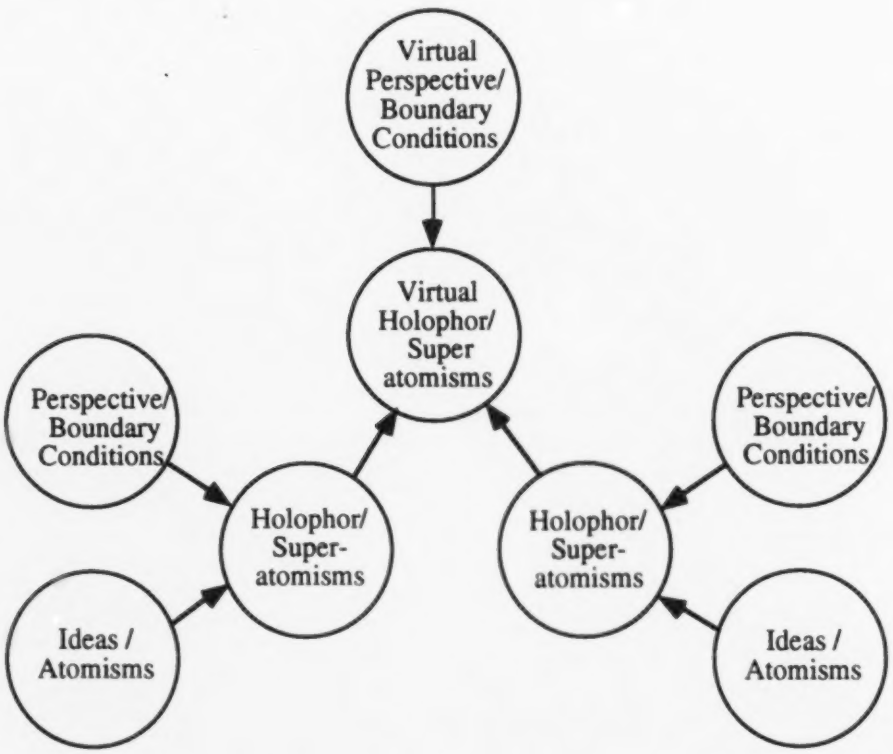
The model describes a lowest level for individual systems which includes atomisms, in this case ideas, an uppermost level which includes boundary conditions, in this case perspectivisation, and a middle level which in the form of the holophor comprises the atomisms in the virtual system. The two individual systems are fundamentally independent of one another or, in other words, there is no form of causal linking between them, but they are linked together in a co-ordinating structure which enables the two individual systems to act as a functional unit.

The co-ordinating structure at atomism level is made possible by the progressive integrative identifying of ideas as described in Elstrup Rasmussen (1994a). Such an integrative identifying, which is always taking place in the social networking, ensures that the persons involved in the co-ordinating co-operation speak the same language at a certain level of generalisation. At the level of boundary conditions, i.e. at the perspective level, the question is slightly different, since the way in which the interaction of individual systems sets the virtual perspective is not necessarily given. And it is precisely here that the problem of leadership arises. If it is possible to ascertain in what manner the virtual perspective is formed in the interaction between individual systems, it is possible to develop a theory of leadership. The only thing which can be known about the virtual perspective in advance is that it must contain a figure, ground, means and goal component, and that the development of the virtual perspective and thereby the universally stable state in the form of a superholophor will set in motion adjustments at the level of atomisms which do not lose their autonomy as a result of the co-ordination but are naturally forced away from given systematic states. When autonomous systems are co-operatively

co-ordinated qualified activity is made impossible, and as a result systematisms are destroyed.

Figure 6.

Illustration of Co-ordinating Co-operation



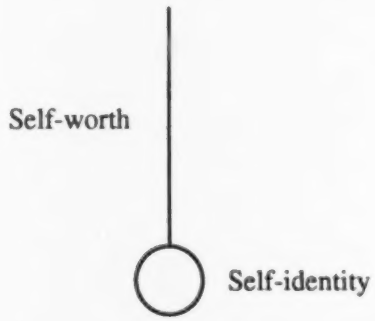
Co-ordinating of Auto-oscillating Systems

As discussed previously, it is fundamental for the understanding of the person as an auto-oscillating system that the system be in a position to dissipate information flows through system components, i.e. ideas, which are assembled through this dissipation. The ideas comprise as a whole the possibilities of the individual autonomous system to handle the flow of information, i.e. to parse the flow and assemble it to make sense. The reservoir of ideas in which the (int(A)) a (ort(O)) mechanism oscillates is in Elstrup Rasmussen (1994b) analysed as a "self". The self includes all that the individual knows and values, i.e. the general possibilities of the individual system can be described as a set of ideas which, as previously mentioned, includes forms of knowledge and values. The most comprehensive knowledge component, which is actualised in a given event, I refer to as self-identity, while the most comprehensive value component is called self-worth. Self-identity is thus the singular or prototypical expression of the way in which the individual knows something in a specific event, while self-worth is the prototypical expression of the way in which the individual places value on anything in a given event. We can also say that self-identity is an organised mass of knowledge, while self-worth is the value measure which is linked to the mass of knowledge which is actualised through a given flow of information. The information-dissipating components of the individual

autonomous system in a given flow of information can be described as a variable mass which is suspended from a string of variable length. This is illustrated as follows:

Figure 7.

The Relationship between Self-worth and Self-identity Described as a Pendulum

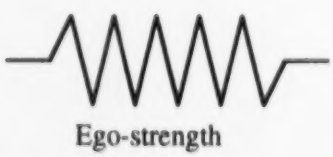


As the pendulum swings it collects ideas from the idea reservoir at the same time as it rhythmically parses the flow of information. In so doing the situational attractor landscapes are assembled, and their inner dynamics, as previously mentioned, result in holophors. There thus exists an inner continuity between the flow of information, the idea reservoir and the relation between self-worth and self-identity, which is expressed in the holophor.

Every auto-oscillating system must, furthermore, also contain an escape mechanism, which rhythmically allows suitable portions of information to enter. In the theory of discontinuity (Elstrup Rasmussen, 1994b) it is argued that, in order for the person to be comprehended as the "ego" which as intentional agent is objectively oriented, i.e. that the "ego", as agent in the form of intentionality, exerts pressure on the objective at the same time as the objective offers resistance to the force exerted upon it. As "ego", the person can be described as a ratio between stress and strain, since "ego" resists and moves forward at the same instant. The stress/strain ratio can as "ego" be described as elastic rigidity. "Ego" involves an elastic rigidity which is thus determined by the event-specific ratio between intentionality and orientation. "Ego" as elastic rigidity is named "ego-strength". If "ego" is very elastic, meaning that the stress/strain ratio is low, ego-strength is also low and if ego-strength is high, i.e. "ego" is very rigid, then the stress/strain ratio is high. Ego-strength can be described as a spring in the following manner:

Figure 8.

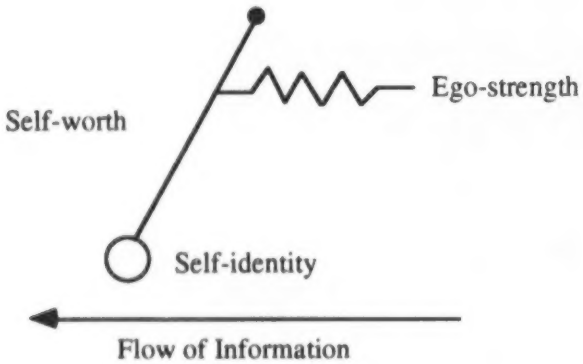
Ego-strength Described as a Spring



The individual auto-oscillating system can now be described using the following model:

Figure 9.

Model of an Individual Auto-oscillating System

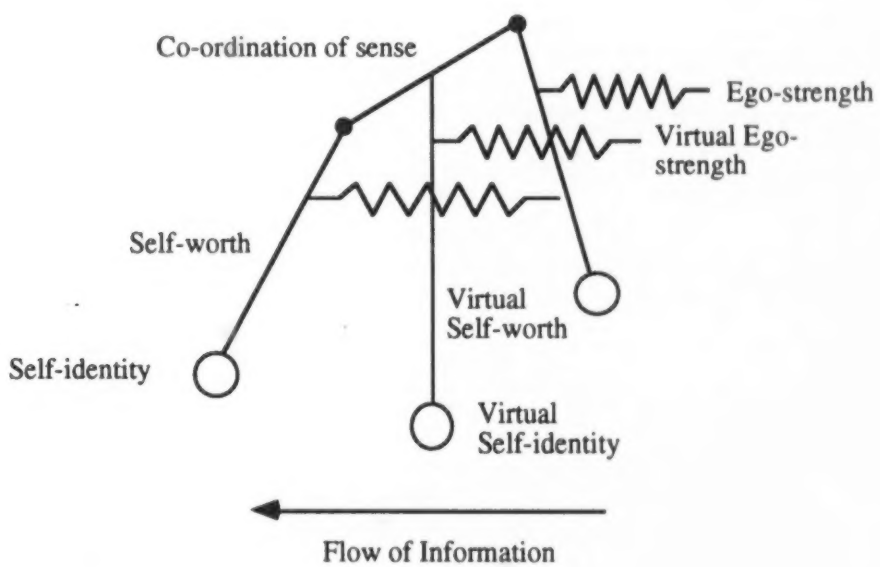


The model illustrates that the relationship of the flow of information to the ego-strength functions as the escape mechanism which through the variable self-identity and variable self-worth parses and assembles the flow of information into the attractor portrait which is the foundation of the holophor. It is this process which is categorised by the border condition perspectivisation into a figure, ground, goal and means form.

Rhythmic phenomena of this type can as previously mentioned be co-ordinated according to the model proposed by Kugler and Turvey (Kugler & Turvey 1987; Newell et al., 1989). In the present context this means that the two pendula assembled behave as one virtual pendulum, as shown in the model below.

Figure 10.

Model of a Virtual System Comprised of Assembled Auto-oscillating Systems

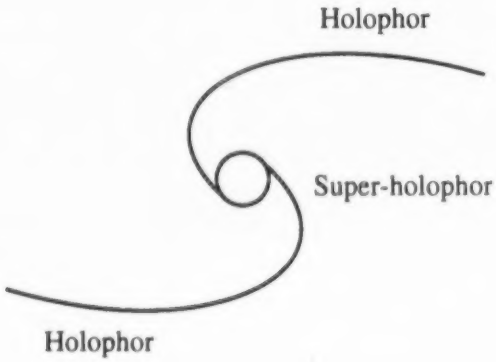


In the event that two auto-oscillating systems are linked together, they function as one virtual system in which holophors are co-ordinated to form a superholophor. The co-ordinating process can also be regarded as an innovative searching process which is aimed at establishing the stable state which fulfils both auto-oscillating systems.

The co-ordinating motion, which Kugler and Turvey (1987) call the magnet effect, can be described using the following model:

Figure 11.

Illustration of the Magnet Effect



The figure illustrates how the one and then the other holophor are moved via the magnet effect towards a stability which the self-referential autonomous systems with their mutual difference themselves create through co-ordination. It is this searching process which is referred to as leadership. Leadership thus embraces a double movement in which the one part should be able to be designated as leading and the other as assisting. Or the one auto-oscillating system will appear as leader and the other as assistant through the magnet effect, as the result of which an asymmetry must exist in leadership which is so organised that the assistant in one sense or another arrives at the same spot as the leader. This unelaborated description could perhaps be interpreted to the effect that the leader has control of the assistant. For example such control could be understood technically in such a way that the leader, through his qualifications, formulates the activity conditions of his follower. The leader, for example, has such qualifications that he or she is in a position to construct the necessary tools: machines and sets of rules which control the activities of the assistant in such a way that make the assistant operate just as the leader wishes. We could also imagine that the leader controls his assistant through reward and punishment within the limits a dependency relationship sets. The leader can, for example, adapt the activity of the assistant through behaviourally modifying systems of reward. Such forms of control would, however, fall under the concept of administration, as described in Elstrup Rasmussen (1996). The moment it is a question of the leader having systematic control, of one form or another, over the boundaries of the follower, the leader is defined as administrator and the assistant as operator. In such a relationship the operator develops himself systematically, i.e. on a qualified basis, within the boundaries which the administrator in a qualified fashion has systematically erected. Administration is not leadership.

In leadership the difference which exists between the one process of the magnet effect and the other should be able to be explained by the interplay between the components included in the auto-oscillating systems: self-worth, self-identity, ego-strength and perspectivisation placed in relationship to the flow of information. On the basis of this

interplay a series of hypotheses can be proposed concerning leadership, as it develops in the form of co-ordinating co-operation between the person who can be designated as leader and the one who can be designated as assistant. The basis for the individual hypotheses will be that what is "larger" has greater influence in the magnet effect than what is "smaller", as a result of which what is "larger" appears as leader and what is "smaller" as assistant. It is thus not determined in advance who will act as leader in the co-ordinating co-operation and who as assistant. A leader is not something one is as a person, but something one becomes in a specific event.

Leadership Hypotheses

In the following I shall attempt to derive a few preliminary hypotheses that are derived from the individual components. These hypotheses will be based on the question: Assuming that all other things are equal, what will such a difference between a specific component in the one and the other auto-oscillating system mean for leadership?

Ego-strength

The ego-strength which is associated with the escape mechanism is a clock function. As a clock function the ego-strength parses the flow of information over time. The ego-strength thus determines decisively how long or short are the steps which can be taken in the flow of information. If viewed in relation to perspectivisation I first of all assume that ego-strength in relation to the flow of information determines whether perspectivisation has the possibility of setting all the categories, since it is the ego-strength which determines whether the pendulum, so to speak, swings through the entire area marked off by the border conditions. The ego-strength thus determines whether figure, ground, goal and means holophors will all be produced. It has been empirically shown that a text will (almost) always produce a figure, most often a ground, but more seldom means and goal holophors. I therefore assume that a special ego-strength is required in a given event to be able to direct the event towards the goals and provide the means necessary for movement toward the goals to occur.

Within this framework the leadership hypothesis could be that the person who can set both goal and means holophors quite simply sets the virtual goal-means boundary conditions for leadership. If both auto-oscillating systems are in a position to set goals it will be the longer time perspective which will exert the greatest influence. There will thus be a tendency for the one having the greater time perspective to appear as leading in relation to the one whose time perspective is shorter. The one who in the flow of information can make sense one month on in time will be leading in relation to the one who can only make sense in the coming week. At the same time I assume that there is an upper limit to how great the distance can be between time perspectives if leadership is to arise. The innovative searching process towards the virtual superholophor, i.e. the magnet effect, requires that the autonomous systems do not differ too greatly from one another in time perspective. To put it another way, if one of the co-operating parties strides forth in seven league boots, while the other has his shoelaces tied together, leadership is an impossibility.

As mentioned, it is the ego-strength which determines in what manner a system moves in and out of attractors. It is thus the ego-strength which prescribes whether a holophor will follow a simple path forwards to stability or whether there are numerous paths towards the final state to be found in the holophor. The difference between these two modes can be illustrated as shown Figure 12.

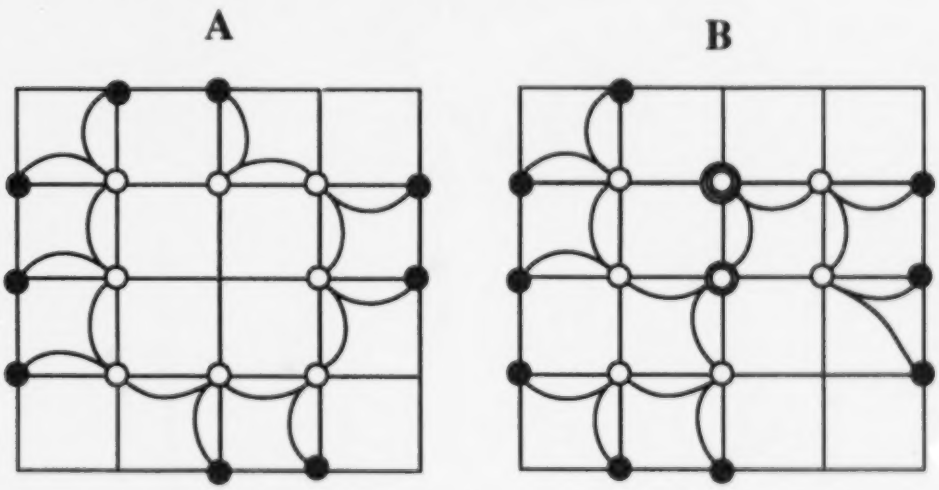
The two figures, A and B, are identical with respect to the number of attractors which comprise their attractor portrait, but as can be seen there are differences in the structure of the holophors. The internally mediating structure of A is comprised of continuously connected discontinuities, while in B discontinuously connected discontinuities. Whereas the A holophor is structured on the basis of one cohesive set of ideas, the B holophor is structured on the basis of three cohesive sets of ideas. The B holophor

is a mental image of a person who sees, so to speak, a given event from different points of view.

On the basis of the assumption that "larger" has more influence than "smaller" it could be assumed that the more structuring ego-strength would gain the upper hand in the co-ordinating co-operation, but it is also conceivable that "one-sidedness" has the strength to win out. Since an uncertainty exists here, it becomes an empirical question as to whether the one or the other will be the case. It could also be possible, for example, that one-sidedness in goal and many-sidedness in means could be what matters. Nor is it inconceivable that the relationship between one-sidedness and many-sidedness in each of figure, ground, goal and means, could prove conclusive for establishing leadership. The same relationship would presumably be of importance for the effectiveness and efficiency of leadership respectively, where effectiveness is defined as fulfilling goals and efficiency as following the shortest path to that same goal fulfilment. Here it should be pointed out that, in the case that effectiveness/efficiency are specified as measure, leadership will no longer be evaluated on its own premises but according to an external measure. It is a weakness of most examinations of leadership phenomena that they fail to differentiate between the nature of leadership and the external effectiveness/efficiency measure by which this same leadership is assessed. Whether there is a connection between the structure of the superholophor and the effectiveness/efficiency of the leadership is an empirical question which demands an analysis of the organisational conditions in which the co-ordinating co-operation is embedded.

Figure 12.

Illustration of Differences in the Internal Structure of Holophors



Self-identity

The ego-strength has no direct influence on either self-worth or self-identity, it can, so to speak, get the most out of self-worth and self-identity, as the ego-strength can get the system to oscillate at a maximum within the boundary conditions set for it, as a result of which new ideas will be developed and thereby new possibilities for the activation of self-worth and self-identity.

Self-identity has — all things being equal — an independent function. It is self-identity which determines what in a given flow of data comprises the flow of information, just as it is self-identity which forms the holophor's depth and breadth of knowledge.

The basis for the creation of any sense is, as previously mentioned, the human need to reduce the complexity of the flow of information. Our competence is always directed at lowering the complexity with the intent of in the end being able to systematise and thereby administer existence. We are always aiming at creating new routines, in order to be able to repeat ourselves. The wider and deeper our self-identity is, the greater the degree of complexity we can reduce and transform to systematisms. The depth of any sense depends upon the insight embedded in the ideas from which sense is constructed. It could be said that the "expert", by virtue of his insight, can create deeper forms of sense from a complex flow of information than someone who is not an expert. The reason for the expert, all things being equal, becoming a leader as compared to the less experienced person, is that the expert can in fact reduce the complexity to a level where the less experienced person can be included and form his own sense.

Sense, however, has not only an "expert depth", it also has a "generalist breadth". The breadth of sense depends upon the level of abstraction at which an individual makes sense and the higher level of abstraction will, all other things being equal, be leading in comparison to the lower. It is somewhat similar to the time perspective. The one who can handle the broad outlines will, all other things being equal, lead the way in relation to the one who can only make sense on a small scale.

Here it should be kept in mind that it apparently is a prerequisite for leadership that the auto-oscillating systems involved in the co-ordinating co-operation, in one respect or the other set the same flow of information in the flow of data. In order for leadership to arise, the leadership components must be situated in the same flow of information, regardless of whether these two components parse and assemble this stream in different ways.

Self-worth

Self-worth, which is associated with the length of the oscillation component of the auto-oscillating system, expresses the values which are bound to the ideas which dissipate the flow of information. The value component is decisive for the rhythm undertaken by the auto-oscillating system. We could say that self-worth determines the size of the pieces of the information flow parsed. In the holophor the self-worth component is expressed in the degree of resolution of the holophor. The holophor can have a higher or lower semantic resolution, i.e. the attractor portrait and the mediating and final states derived from it can be semantically closer together or more distant from each other.

The hypothesis on the importance of self-worth in leadership is that, in a similar manner, a person who can take larger steps will lead in relation to a person who takes smaller ones. The greater self-worth has more influence on the virtual superholophor than does lower self-worth. This hypothesis involves the paradox that the person who so to speak parses the flow of information most closely, and thereby is actually more in "accordance" with the possible geometries of that flow of information, has less influence than the person who has in effect a more limited grasp of the details of the information flow. Thus it is assumed that co-ordinating co-operation tends to follow the larger perspective. The figure, ground, goal and means are all created, so to speak, from a greater height.

A Contextualisation of the Theory of Leadership

In order to determine the theoretical value of the above-mentioned hypotheses the discourse arising from co-ordinating co-operation in progress must be analysed in connection with the carrying out of concrete tasks. Since such material is not available at present, the following should be regarded as merely a demonstration of how the co-ordinating co-operation appears as mental structures in persons who must and have worked together. The following should thus neither be regarded as confirming or rejecting the said hypotheses, but only as a contextualisation of them. The holophors presented have not emerged from a co-ordinating co-operation but have appeared as an expression

of a co-ordinating co-operation, since they include the expectations of two students for future co-operation and how they subsequently experienced the course of that co-operation. The holophors are second-order models of co-ordinating co-operation. We can thus expect the holophors presented to include knowledge and insight concerning co-ordinating co-operation, despite not being a direct expression of such. We can also expect, as long as co-ordinating co-operation has in fact taken place, that the "expectation holophors" will characterise the subsequent "co-operation holophors". There are two possibilities: either that the "expectation holophor" of one student will be unilaterally embedded in the "co-operation holophor" of the other, or that a mutual embedding will occur. Both instances provide an expression of leadership. The latter form, which thus expresses that leader competence has changed position in the course of the project, is called teamwork. Teamwork could be said to be time-share leadership.

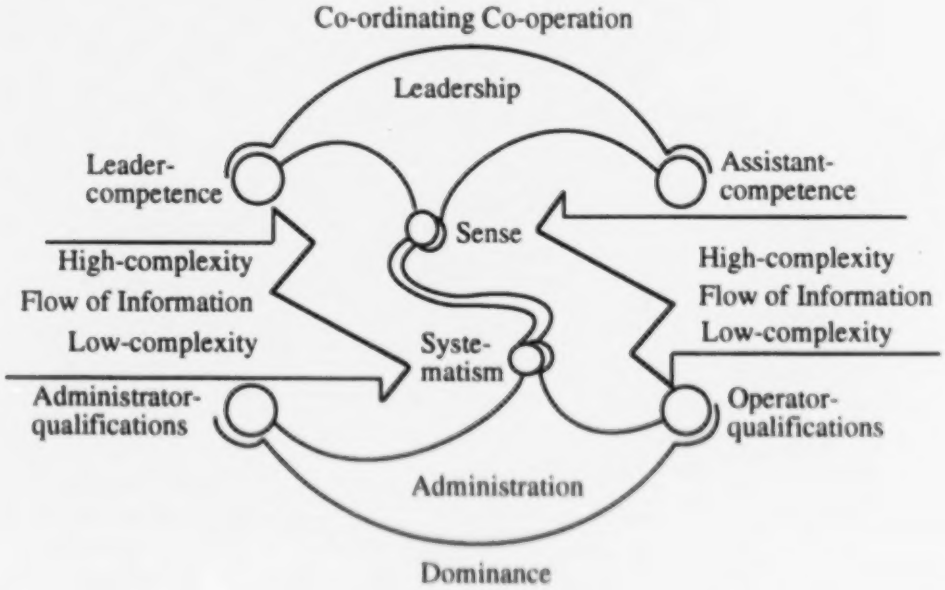
The aim of the following discussion is to demonstrate that the theory of leadership presented here can be expressed in the mental structuring of co-ordination by co-operating persons and that the concepts of the theory can be applied as the context for comprehending these models, as well as the occurrence of a mutual embedding during the course of the co-operation.

The material for the following analyses came from two female students who chose to write their final Bachelor's thesis in general psychology together. Bachelor's theses are usually written on an individual basis. The two students knew each other very well and had, for instance, previously shared an apartment. The thesis, which was written during one semester, received an A grade (11 on the Danish scale). Before commencing their work together, the students were asked to describe how they expected their co-operation to progress. After they had written the thesis, they were asked to describe how the co-operation had progressed.

To facilitate an overall view of the leadership theory I have constructed the following structural model:

Figure 13.

A model of Leadership and Administration

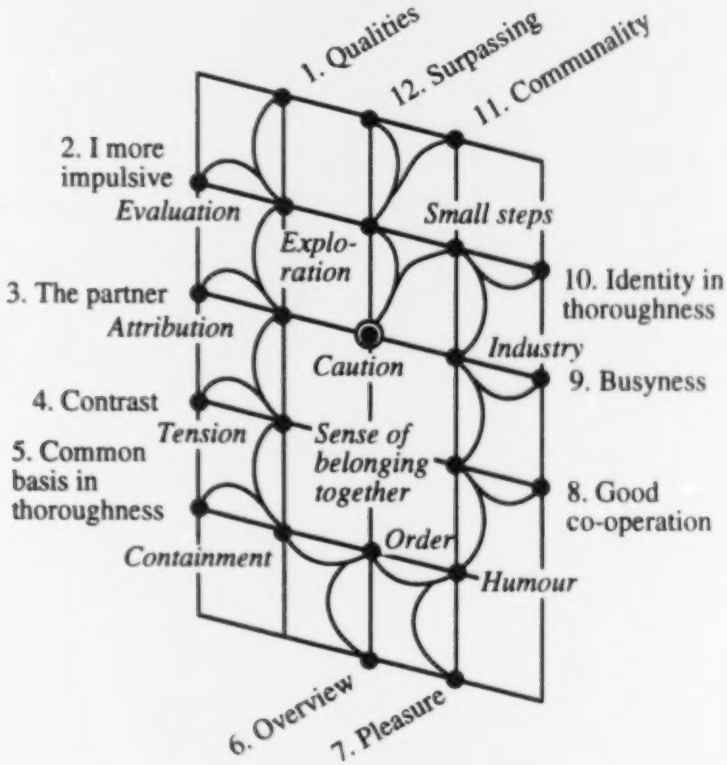


The model illustrates that highly complex flows of information give rise to the making of sense through competence, while low-complexity flows of information enable the activation of qualification-borne systematisms. At the same time the model illustrates the existence of an inner relationship between sense and systematism, where sense-making enables systematic repetition while a systematism orients the sense-making. The model shows as well that co-ordinating co-operation is the constraint which categorises leadership competence as leader competence and assistant competence respectively, and that dominance categorises administration qualifications as either administrator qualification or operator qualification. Here we must keep in mind that administration is constructed differently than leadership. Whereas leadership is an internal unitary process, administration is an external dominance relationship, where the development of one set of qualifications sets limits for the other. Where two qualifications, and thereby two systematisms, progressively set limits for each other, we speak of a synchronisation of activity. Within the administrative domain synchronisation thus corresponds to what has been called teamwork within the leadership domain.

Expectation Holophors

Figure 14.

A's expectation figure



The first point of orientation with regard to the future work is "Qualities", which describes the initial state of the holophor. The next idea, "I more impulsive", expresses together with qualities an "*Evaluation*" of the co-operating partners. A regards herself as

being more impulsive than "The partner", who is therefore credited with the opposite quality through *"Attribution"*. The partner is regarded as less impulsive. In consequence of this "Contrast" appears a contrast which through the attribution of opposing qualities establishes itself as *"Tension"*. It thus appears that A's mental expectations imply that the future co-operation will display a certain measure of tension on the basis of the differing personal qualities attributed to the partners, but in the next state a "Common basis in thoroughness" results in the *"Containment"* of tension. The perceived tension can be held in abeyance by virtue of its existence within a common limit which is determined by the shared basic attitude towards being thorough. It is possible that the tension inside of the basic framework can serve as a dynamic factor which can propel the co-operation forward, but in order for such restricted tension to be productive, it must be supported by some form of order, otherwise the tension will become an internal fight. Through "Overview" the holophor is oriented towards such an *"Order"*. The inner stability of *"Order"* is combined with "Pleasure" to produce *"Humour"*. In this context humour should be understood as in Kierkegaard (1963), who understands the pleasurable order of the Ethicists as humour, in contrast to the irony of the Aestheticists. In "Good co-operation", humour becomes a *"Sense of belonging together"*, which expresses a specifically internal relationship. A sense of belonging together captures a tension-charged but loving enclosedness. A's perceived expectation directly involves a pair-relationship, i. e. of their being together and not of future leadership or teamwork. Both leadership and teamwork demand a task and the task which is to form the reason for the co-operation does not figure in the holophor. It can, admittedly, be seen indirectly, as the sense of being together is combined with "Busyness" in *"Industry"*. The industry in the enclosedness is subsequently further qualified by "Identity in thoroughness" so that this path of entry can be stabilised in *"Small steps"*. This path clearly illustrates an extrapolation of the partners' friendship into their future co-operation. The task has not yet become fully manifest as a significant factor in A's mental picture of the co-operation. This the sense of belonging together does, as this she knows in the form of the existing friendship.

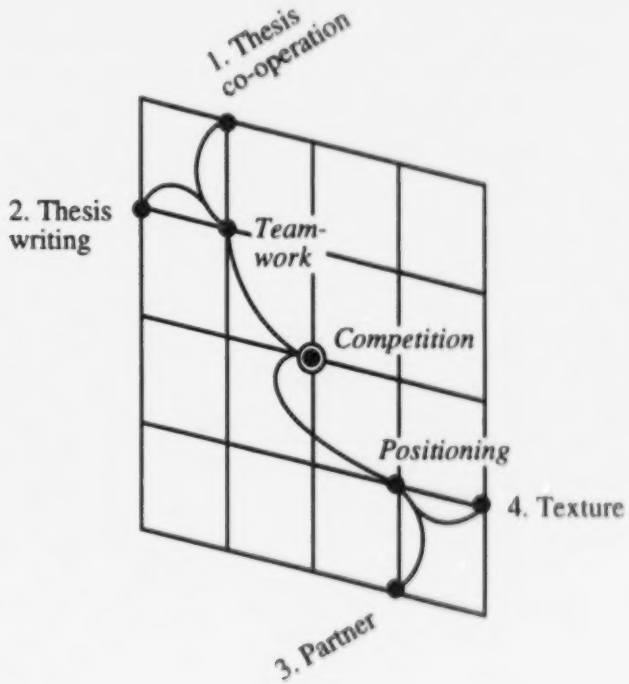
A new access to the holophor is now established, i.e. that of "Communality", which in conjunction with "Surpassing" points in the direction of *"Exploration"*. What is new about this access is the idea of surpassing, which points toward an expectation of the communality possibly resulting in something previously unknown, or perhaps itself being surpassed. The way towards the unknown, however, merges with *"Small steps"*, and thus the final state is *"Caution"*. The surpassing is definitely viewed as a possibility but no risk is to be taken. The friendship is not to be willingly subordinated. It appears as if the holophor expresses more of an orientation towards a sense of belonging together than towards the task which is to be completed. There is thus nothing in A's expectation figure which gives rise to the belief that she conceives of their future time together as task-oriented teamwork, let alone leadership. The cautious exploration could be an indication of the existence of the desire to surpass the sense of belonging which has been dominant in their earlier time together. This possibility is not, however, supported by any ground. The expectations of the co-operation are so to speak without ground, but there is a conception of the means by which the cautious surpassing can be ensured.

The initial state in the means holophor shown in Figure 15 is "Thesis co-operation", which together with "Thesis writing" produces just that *"Teamwork"* which apparently is supposed to be part of the means to phase out the sense of belonging together. The other access involves "Partner", which leads over "Texture", which is a set of external conditions, towards *"Positioning"*, since B is placed in equivalent relation to A through the texture. Where teamwork implies an internal relationship imposed by the task itself, i.e. a structure, positioning here points to the external relationship which exists between the partners, which contributes to a specific texture, i.e. in a dominance-balanced context, where the one position determines the limit conditions of the other and vice versa. The positioning is the qualification-determined pendent to teamwork. Positioning is an arrangement in a texture without task orientation or, in other words, without the mutual systematism which was analysed previously as synchronising. Such

an internal-external relationship, which thus includes a connection between teamwork and positioning, can be described as *"Competition"* in the thesis, a competition which moves forward in the form of a comradely duel. There is thus no question of competing, for instance, for ownership of the thesis, but of competing within the framework of the thesis, for instance, to contribute the most to the common product. We can also say that the final state, competition, describes a dynamically shared unity, the basis of which is the relationship between common sense-making and an unsystematic positioning.

Figure 15.

A's Expectation Means



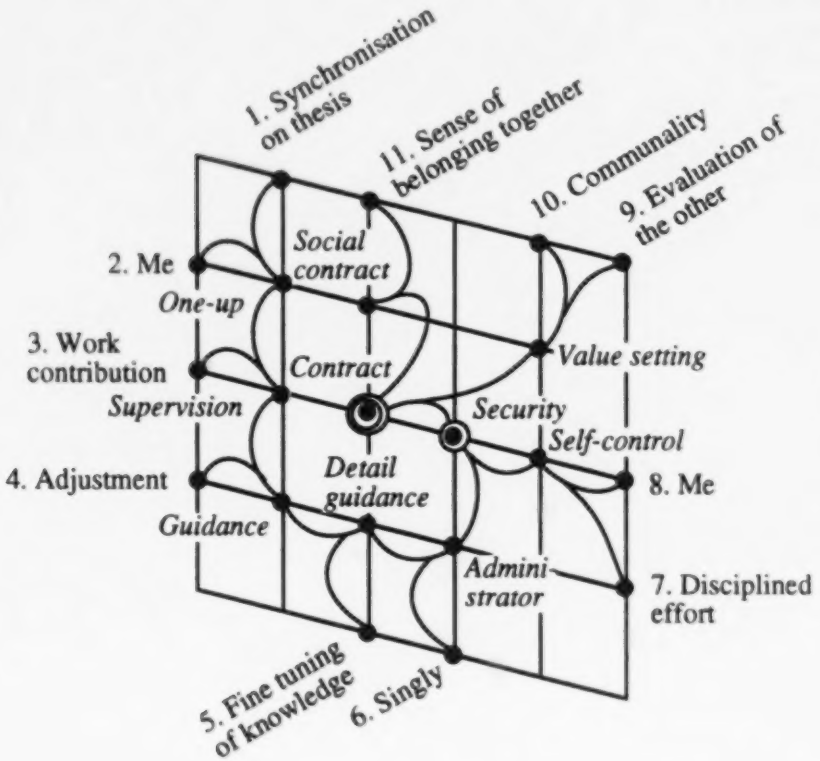
A obviously imagines that the previous sense of belonging together will be cautiously transformed to something else by means of the internal competition involved in the thesis. As an access to the co-operation A focuses on the utilisation of the concrete work on the thesis to transform the private friendship to a regular personal co-operative working relationship

The initial state in B's Expectation Figure shown in Figure 16 "Synchronisation on thesis", indicates that B perceives the future co-operation as task-oriented but at the same time expects that the task will become materialised through a synchronisation of the contributions, i.e. through a texture and not directly through teamwork. This state is further strengthened with "Me" to a feeling of being *"One-up"*. B obviously perceives herself as the one who will stand over the "Work contribution", or provide *"Supervision"*. This supervision creates, through "Adjustment", the stability of *"Guidance"*. This is a supervision which is constantly adjusting, controlling the limits for what he or she is supervising. "Fine tuning of knowledge" is now introduced as a state.

The guidance shall thus take place at the level of knowledge, which is not surprising as the thesis is to be an intellectual achievement, but it is clearly important that the guidance be fine tuned, and thus the resulting stability can be defined as *"Detail guidance"*. Nor is there any doubt that the guidance is to be entrusted to B, who through "Singly" reaches the preliminary conclusion of the introductory expectation path in the form of the idea *"Administrator"*. A new access to the holophor is now established, that of "Disciplined effort", which in combination with "me" points towards *"Self-control"*. B must discipline herself, just as she is to ensure the other's discipline, i.e. she must be dominant in the texture. As administrator, self-control therefore moves towards an internal stability in the holophor which could be described as *"Security"*, since it is self-control as administrator which points to the possibility of phasing out repeatable routines. Security summarises B's direct expectation of the co-operation. Through her administration of the thesis process the assurance will be created that a result will finally be produced from their labours.

Figure 16.

B's Expectation Figure



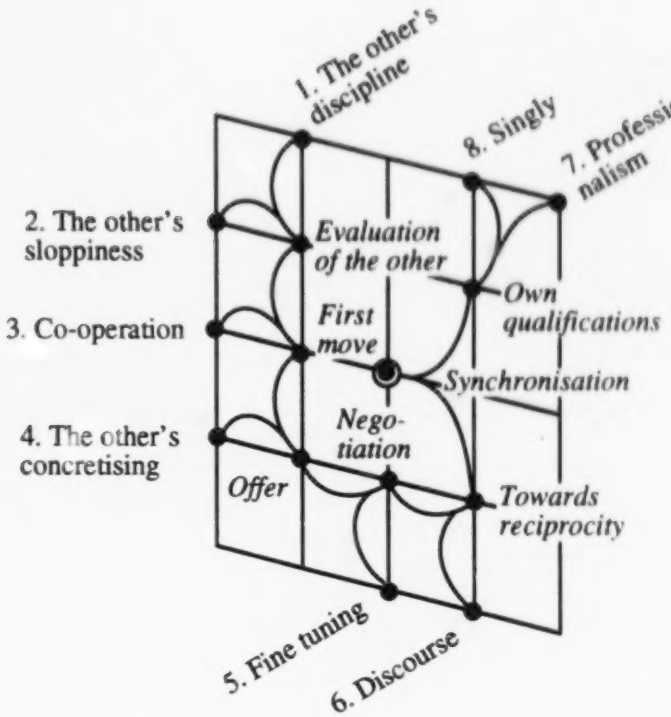
The holophor next displays the access "Evaluation of the other", which merges with "Communality" in *"Value setting"*. A value is set on the communality through an evaluation of the other, whom B already knows. In contrast to A, who makes a comparative evaluation, B evaluates the other directly, i.e. sets a direct value on the other. In order to maintain its *"Security"*, such a *"Value setting"* must be done as a *"Contract"*. But

here it must be noted that the idea of contract is so deeply embedded in her consciousness that it presumably escapes the person's notice.

"Contract" is finally joined with "Sense of being together" so that the final state, *"Social Contract"* is established. In the holophor the initial idea of administration of the process through an evaluation of communality has been transformed to the idea of the social contract. This idea is maintained by a ground.

Figure 17.

B's Expectation Ground



The point of departure for the ground is an *"Evaluation of the other"*, which is initiated by "The other's discipline" and "The other's sloppiness". The expectations comprise a basic evaluation of the partner. This evaluation merges through "co-operation" to produce the *"first move"* If the other is assessed as being disciplined and not sloppy, and co-operation is a necessity, a first move can be made. To this possible co-operation is added "The other's concretising", which refers to the concretising by A of B's more abstract approaches. The first move thus appears as a concrete *"Offer"*. If the other does in fact concretise B's more abstract approach, co-operation can be offered. Since this offer is obviously subjected to a "Fine tuning", this is a question of a special instance of offering, that is *"Negotiation"*. Since the negotiation merges with "Discourse" a preliminary internal stability is created in the form of *"Towards reciprocity"*. The negotiation in the ensuing discourse of the thesis must apparently proceed in such a manner that a reciprocity can be created from the difference which is perceived by B, as she regards herself as the more abstract-minded in comparison to A, who is regarded as more concrete in her understanding. It is thus not a question of the more concrete viewpoint being

worked into the more abstract, but of the negotiation of how the abstract approach is to be concretised, i.e. illustrated by the other in the thesis, which becomes the ground for unity. Or that the abstract approach should serve as a limit condition for the concrete.

A new access is subsequently created when "Professionalism" and "Singly" merge in *"Own qualifications"*. The professionalism which B alone has serves as her qualifications. The final state, which unites own qualifications with the movement towards reciprocity is named *"Synchronisation"*. In the ground the given qualifications are to be synchronised through perpetual negotiation. This ground provides good support for the social contract which is the final state of the figure. There are indications that B expects that she will administer the course of the project, but basically her mental picture of the upcoming co-operation is characterised by images of social equivalence, albeit with a tendency to desire to set limit conditions for both the other's contribution as well as their mutual systematic contribution.

As is evident from this, there are fundamental differences between the expectation holophors of A and B. Where B feels that the thesis should be constructed upon an administrative synchronisation, where she herself serves as administrator of the process, A conceives of the thesis as a possibility to alter her relationship to B from the more private to the personal sphere. A's mental expectation image tends to move towards the competition-flavoured co-operation, i.e. teamwork, while B's moves towards guided synchronisation, i.e. administration. Neither A nor B expects a process which could be understood as the co-ordinating co-operation that is described as leadership.

Co-operation Holophors

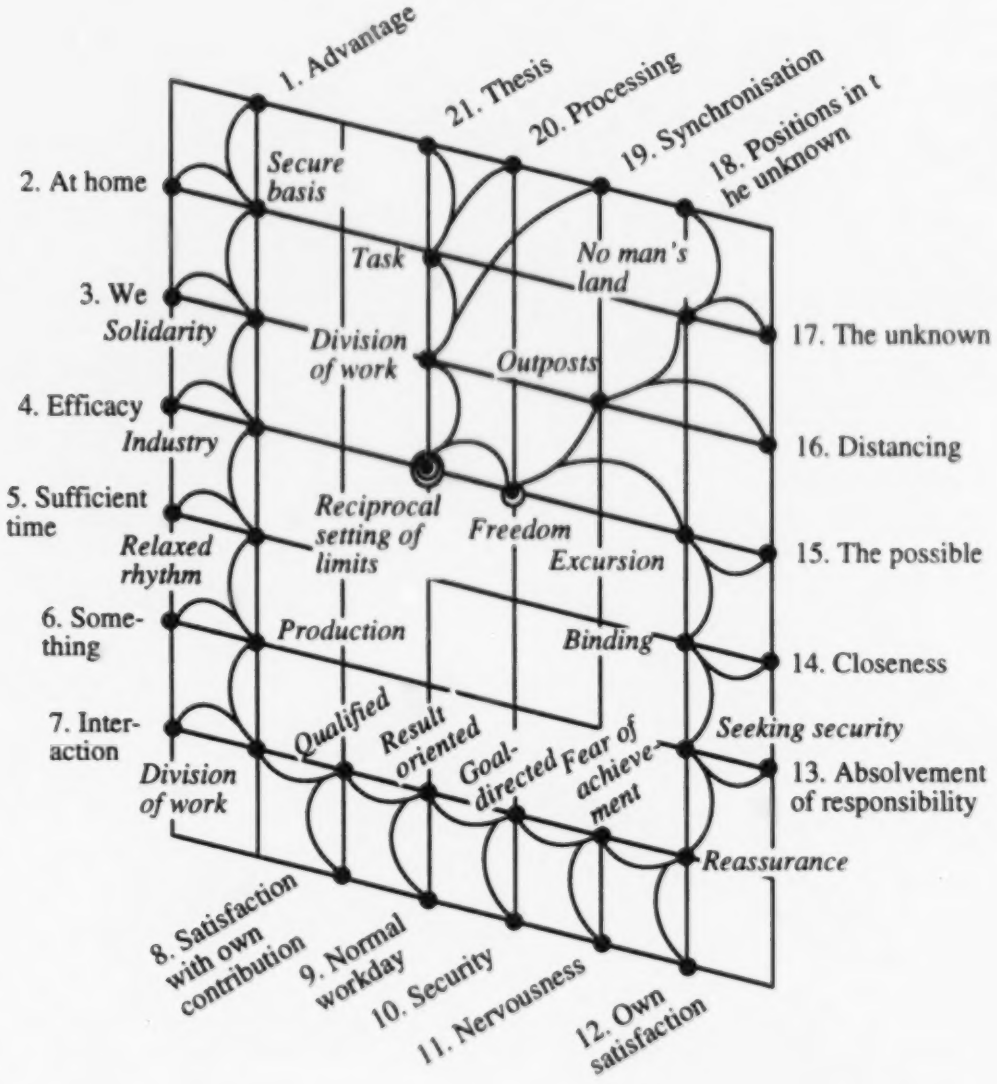
The initial state in A's co-operation figure as shown in Figure 18 can be described as "Advantage". Either one or the other has an advantage, which in combination with "home" provides a *"Secure basis"*. And it must be B, who has this advantage, as the work on the essay has taken place in her home, because it very simply took place on her computer. The secure basis, however, is expanded by "We" in such a way that the stability of "Solidarity" appears. Once we have a secure basis, we stick together. This solidarity must, however, include "Efficacy". It is not a question of the solidarity being effective, but of its including one form of efficacy or another, and thus the stability *"Industry"*. But "Sufficient time" is also required, as a result of which industry is transformed to a *"Relaxed rhythm"*. The relaxed rhythm must capture "Something". This relaxed rhythm is thus object-directed, as a result of which *"Production"* must be the term which captures this stability. Here the essay itself thus puts in an appearance in A's mental picture of the co-operation. The essay has naturally enough become a more substantial, if not as yet especially significant, part of A's world of ideas in this context. Production must, however, take place through "Interaction". A relationship thus exists to enable production, but such a relationship is normally described as *"Division of work"*. In this division of work "Satisfaction with own contribution" finds expression. A clearly considers herself as *"Qualified"* in this process, which, where the process is considered as a "Normal workday", is posited as *"Result oriented"*. The process is considered as a workday during which results will be produced by virtue of own qualifications.

Since the next state is "Security", the result orienting can be specified as "Goal-directedness" which, however, through the "Nervousness" introduced can point towards a certain *"Fear of achievement"*. The fear of achievement is kept in check by "Own satisfaction", so that the stable state *"Reassurance"* appears, but not so much as to prevent an idea of "Absolvement of responsibility" from creating a trajectory towards *"Seeking security"*. This seeking of security in closeness, or a pair relationship, can be regarded as a *"Binding"*, which in "The possible" opens the way for an *"Excursion"*, as a preliminary end point. In binding there are in fact possibilities for excursions which are not frightening by virtue of the binding. In her description of the co-operation A repeats the point of departure for her expectations in the close togetherness, but it is also possible to see an opening in another direction. This opening is strengthened by the new access introduced through "Distancing", which through the combination with "The unknown" posits a *"No*

man's land". The great distances in the unknown mark off a territory which no one can lay claim to, but which through the pointing out of "Positions in the unknown" transforms the no man's land to *"Outposts"*. These outposts are combined with "Excursion" to the stable state "Freedom", as freedom includes the possibility of moving out from a specific position.

Figure 18.

A's Co-operation Figure



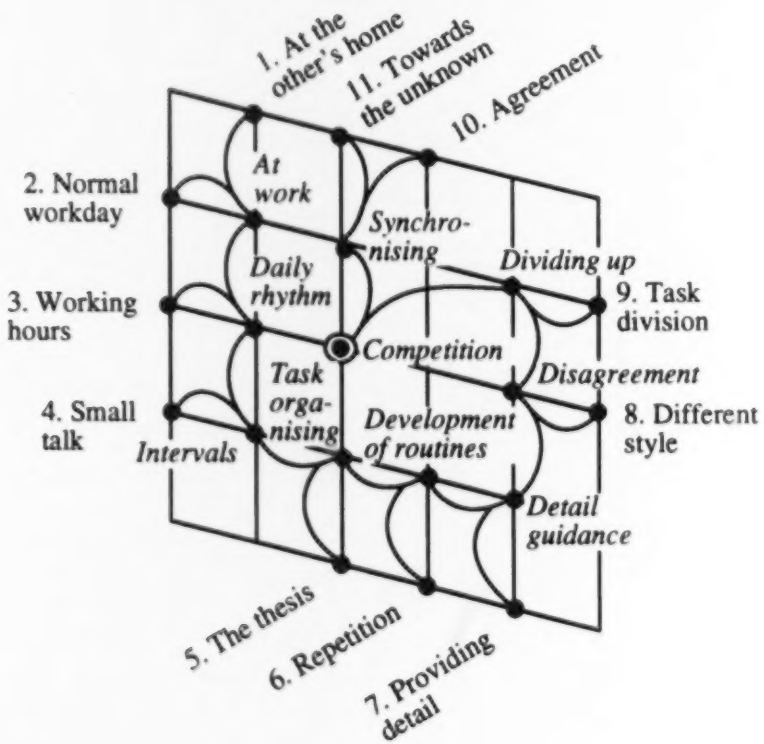
There are indications that A has, as expected, escaped from the rather confining relationship with her partner through their joint work. It is, however, interesting that the thesis of the co-operating partners does not play an especially large role in the description of the co-operation either. Their thesis is not introduced until the final access, which is

headed by "Synchronisation". Synchronisation, however, does not merge directly with another state. "Processing" must first be combined with "Thesis" in *"Task"*, since their task is, in fact, to process their thesis. *"Task"* and synchronisation point towards a definite *"Division of work"* which is not further defined. When work concerning a task is to be synchronised this is due to a given division of work. The division of work is combined with *"Freedom"* in a *"Reciprocal setting of limits"* which comprises the final state. Freedom in the division of work can quite simply only exist in so far as limits are set for the other in the relationship. The holophor here illustrates a small, self-organising social system, which has arisen through the internal constraints of the system. A circular causality has been established in which the internal components set conditions for each other. It is thus a question of the holophor, in contrast to the classical linear causality, being able to express the circular causality associated with self-organisation.

Observed generally the holophor could indicate that A has achieved what she wished: release from the close togetherness, while at the same time this release has drawn on B's expectations of the social contract. But what, then, is A's own ground for the obvious success in establishing a release?

Figure 19.

A's Co-operation Ground



The initial state in the ground is described as "At the other's home", which together with "Normal workday" indicates the point of departure *"At work"*. To go to work at the other's home with daily "Working hours" that provide a *"Daily rhythm"* which includes "Small talk", so that the daily rhythm is broken up by *"Intervals"* into

sections of time. "The thesis" is introduced next. The intervals surrounding the thesis must include a *"Task organising"*, since the intervals introduce the idea that every thing has its own time. The organisation of the thesis merges with "Repetition" in *"Development of routines"*. Obviously, organisation is not to take place through innovation, i.e. making sense, but through repetition, which in fact points to a routinisation of the thesis. Through "Providing detail" the path leads to *"Detail guidance"*. There is some indication that B's more administratively oriented expectations have won the day in the co-operative process, but the state "Different style" disrupts A's subordination to the administrative efforts which might be exerted by B with the result that *"Disagreement"* appears in the holophor. Upon merging with "Task Division", this disagreement produces a temporary stability which could be described as *"Dividing up"*, since the disagreement gains the upper hand in the task division. They proceed by following different routes, so to speak.

A new access to the mental picture of the co-operation is initiated by "Agreement", which as mentioned previously holds a central position in B's expectation holophor. The agreement merges with "Towards the unknown" to *"Synchronisation"*. To head towards the unknown by agreement quite simply demands a synchronisation of movement. Synchronisation is the idea which most fundamentally characterises B's holophor. There is thus also some indication here that A's sense-making in connection with the co-operation is extensively coloured by B's expectations, but as the final state in A's holophor is *"Competition"*, which results from a merging of synchronisation and dividing up, it appears that the means which could be expected to be used by A have, in fact, come to form the ground for achieving her cautious movement away from the sense of belonging together. The competition, however, which appears in the co-operative ground is of a slightly different character than that which emerged in the expectation means, since it does not involve teamwork but only synchronisation. In the competition of the co-operative ground it is more a question of setting one's stamp on the thesis at all than of an internal duel to contribute more within the framework of the thesis.

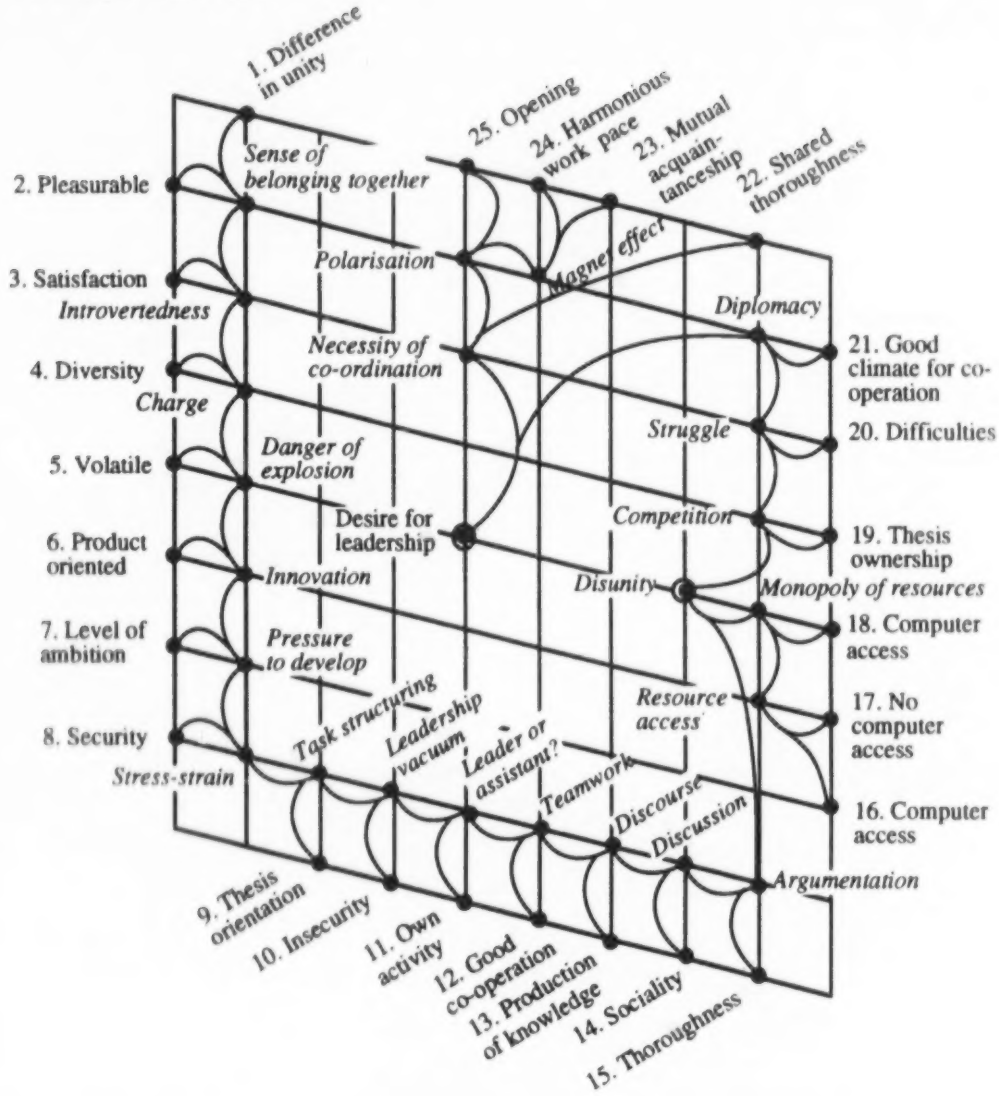
It is important to note that here the holophor is pointing out, through semantic means, the basic phenomenon that the dissipative geometries, which emerge thermodynamically when two or more flows compete, describe states which satisfy the flow problems for competing processes. At the level of the holophor it is also pointed out that co-operation cannot exist without a competition to be heard and to win time in unity. Unity and competition are two sides of the same coin. Competition is thus a necessity in co-operation, regardless of its having to appear in a form which is upsetting for the partners.

In general the dynamic movements indicate that, all things being equal, through her expectations of a more rigorous administrative process, B has set her mark on A's process. A has thus only partly achieved what she envisaged. Freedom has been achieved, but the experience she had of reciprocity in possible teamwork has been transformed to competition and a reciprocal setting of limits.

The initial state in B's co-operation figure as shown in Figure 20 can be described as "Difference in unity". There are differences, but these differences exist within a communality which through the state "Pleasurable" merges into *"Sense of belonging together"*. The pleasurable company, which is not challenged, implies a sense of belonging together. This sense of belonging together is further narrowed by "Satisfaction" to a state which could be described as *"Introvertedness"*. This stability is, however, immediately challenged by "Diversity" to a *"Charge"* which is accentuated through "Volatile" to something which could be described as *"Danger of explosion"*. The sense of belonging together is apparently so confining that its boundaries are in danger of being exploded. The danger of explosion is, however, captured by the underlying process, which is "Product oriented", with the result that the stability *"Innovation"* is produced. Instead of exploding the internal tension is transformed into external change.

Figure 20.

B's Co-operation Figure



There is some indication that B captures mentally the diversity of the partners but that she at the same time, influenced by A's expectation of teamwork, experiences this diversity in a productive way. The beginnings of a transformation of the administrative expectation in the direction of teamwork can be seen in B. Through the "Level of ambition", innovation is stressed, leading to *"Pressure for development"* which, however, is immediately counteracted by "Security". As a result of this a *"Stress-strain"* state arises in the process, i.e. a structuring tendency. When something is pressed which exerts resistance, a structure arises (Kugler & Turvey, 1987). When this structuring tendency merges with "Thesis orientation" the stable state *"Task structuring"* is established. To have the structure oriented towards the thesis which is to be written, the underlying task must be structured. In the course of task structuring, however, an "Insecurity" is intro-

duced which must mean that it is not clear by whom or how such a structuring is to take place, and thus the idea of a *"Leadership vacuum"*. Into this leadership vacuum "Own activity" is injected; this is unspecified, and thus the idea of "Leader or assistant?" is imposed. It is clearly not specified who is to lead and who is to assist. The "Good co-operation" which is introduced next does not answer the question of to what extent one or the other partner is to fill the leadership vacuum, but instead places *"Teamwork"*, since good co-operation sets the leadership as unspecified. Teamwork then merges with "Production of knowledge" to *"Discourse"*, which is exactly the ideal form of teamwork.

The discourse, however, is disrupted by "Sociality" to *"Discussion"*. The discourse is positioned as a social relation and thereby loses its unity to become a discussion between positions. The social contract from the mental expectation state is clearly pressing into this process, which is otherwise characterised by A's expectations. The discussion is then specified by "Thoroughness" to *"Argumentation"*, which concludes the introductory string. We thus have a string of connected ideas which point towards teamwork — presumably characterised by the influence of A's expectations — but teamwork does not manage to finally achieve a dominating place because it is superseded, so to speak, by B's own expectations of establishing a social contract. If it is to be a question of teamwork the leadership vacuum obviously must be filled.

A new string is introduced into the holophor which points towards "Computer access" and "No computer access", which merge in *"Resource access"* and which in turn becomes *"Resource monopoly"* through yet another "Computer access". The fact that it is she who has direct access to the resource in which their joint thesis is embedded is clearly a major factor in B's mind. The monopoly of resources draws the state argumentation to a more basic *"Disunity"* which has to be directed towards resource access. This disunity is intensified in "Thesis-ownership" with the result that the *"Competition"* expected by A appears in B's mental model. Competition is joined by "Difficulties" to form a *"Struggle"* which, since a "Good atmosphere for co-operation" is preserved, requires the idea of *"Diplomacy"*. If B is to maintain her expectations of a social contract, she must be guided by diplomacy in the clear competition over the thesis they produced.

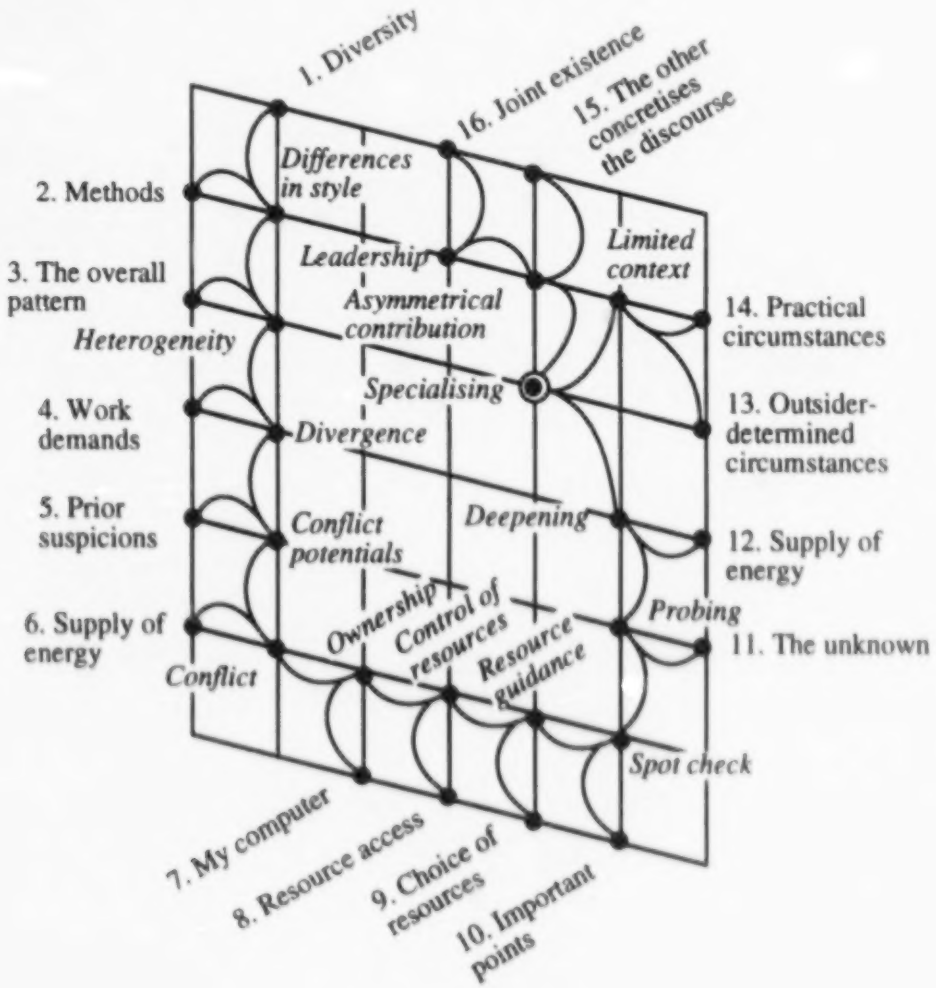
Next a new and divided access is introduced. "Shared thoroughness" is the point of departure. An idea of communality is thus posited, which is embedded in the thoroughness involved in the work on their joint thesis. This communality merges with another string, whose point of departure is "Mutual acquaintanceship" and which through "Harmonious work pace" is transformed to a *"Magnet effect"* as described by Kugler and Turvey (1987). An "Opening" of the magnet effect, however, points towards the *"Polarisation"* which in combination with shared thoroughness creates the idea of "Necessity of co-ordination". If there is to be a shared thoroughness, which at the same time includes a polarisation, this must be co-ordinated by necessity. An undecided idea of teamwork thus lies behind this string, but it cannot be realised directly because the other string forces a diplomacy upon it, as the result of which the final and deep-structured state becomes *"Desire for leadership"*. It is not clearly apparent whether B in actuality wishes to be the leader or wishes to be led, but an answer can perhaps be found through the co-operation ground. In any case it appears that A has pushed B in the direction of the idea of leadership, while B has pressed A towards the idea of administration.

The initial state in B's co-operative ground can be described as shown in Figure 21 as "Diversity", which through a merging with "Methods" is stabilised in *"Differences in style"*. B perceives the different styles of the partners especially in the approach to "The overall pattern", which B regards as her domain. As a consequence of this the idea of "Heterogeneity" is formed which, in combination with "Work demands", produces *"Divergence"*. B has formed a mental structure which indicates that the partners move along two tracks and where she herself follows the more superordinate path through the overall pattern. "Prior suspicions" indicates that the idea of divergence is not foreign to her. She has also in her expectation figure introduced the idea that the other is to concretise her more abstract approach. Prior suspicions merge with divergence into *"Conflict potentials"*, which through "Supply of energy" produce a real *"Conflict"*. The idea of

conflict is accentuated above the place where the thesis is located, i.e. "My computer", and thereby becomes a conflict of *"Ownership"*. This idea is then differentiated through *"Control of resources"* towards *"Resource guidance"* above "Resource access" and "Choice of resources". It clearly becomes an idea of importance to B to have control of the thesis, but not total control, since the guidance is only introduced through "Important points", of which *"Spot check"* becomes the internal stability which basically summarises her own expectation of a certain degree of guidance and A's expectation of freedom through competition. It is not inconceivable that just this spot check has moved A's expectation of a friendly structural duel towards a more textual competition. If A has been subject to a spot check, it is not inconceivable that she has, so to speak, given up the idea of teamwork in favour of synchronisation.

Figure 21.

B's Co-operation Ground



In B's co-operation ground *"Spot check"* is now turned in the direction of "The unknown" to "Probing". The unknown terrain which the thesis involves is explored point

by point. With the "Supply of energy" this process leads to *"Deepening"*. The locations explored, are thoroughly explored. B now pauses momentarily in the formation of her mental picture of the co-operation. Due to the internal conflict over style and ownership of the product the process is clearly not perceived as continuous teamwork but rather as a point-by-point deeply-probing process.

A new access is now introduced which initially includes externally "Outsider-determined circumstances", which the writing of a thesis naturally is. The thesis is outlined by the degree requirements. These outsider-determined requirements are concretised through "Practical circumstances" to a *"Limited context"*. The context in which the co-operation is to take place is limited by the degree requirements and the concrete circumstances comprising the co-operation. This inner stability is subsequently combined through "Deepening" to the deeper level of *"Specialisation"*. Within the limited context a deepening is to take place, which is only possible through specialising. The stable state specialising meets "The other concretises the discourse" in an *"Asymmetrical contribution"*. The theme introduced earlier of B's abstract and A's concrete contributions is thus taken up once more through the pointing out that the other is different, the result of which is the idea mentioned of an asymmetrical contribution. The asymmetrical contribution in "Joint existence" points towards *"Leadership"*, which is the final state. A close agreement is thus visible between the desire for leadership in the figure and the leadership in the ground. There can furthermore scarcely be any doubt that B's holophor includes strings which indicate that she regards herself as that leader.

On the whole it would appear that A has moved the co-operative process in the direction of teamwork, as a result of which B, who saw herself as administrator, now sees herself as leader; meanwhile B has moved the co-operative process towards administration, as a result of which A, who wished to achieve freedom through internal competition, now sees herself as part of a synchronisation. As has been discussed, the mental models pointed out by the theory have thus become mutually interwoven through the co-operation. That this should be the case supports the claim that Scanator is in fact capable of capturing co-ordinating co-operation which actually occurs. It comes perhaps as a surprise that A should not perceive the co-operative process as teamwork even if both her expectation holophor as well as A's co-operation holophor point in this direction. This might be attributed to the fact that B's co-operative holophor only has leadership as a desire in its deepest figure state. It is thus conceivable that in reality it is the synchronised relationship which to an overwhelming degree has been realised through the mutual "external" competition.

There is some indication that it may be B who has had the largest deciding influence on the co-ordinating co-operation, i.e. has been the real leader. That this is in fact the case is based on the idea that the more abstract self-identity, all things being equal, will be leading in relation to the less abstract, a relationship which is expressed in any case in B's holophor and not contradicted in A's.

Concluding Remarks

As mentioned in the introduction, the objective of the present work was to develop a functional concept of leadership within the framework of Scanator, which includes the theory of discontinuity and Perspective Text Analysis. This objective is to be regarded as a result of the critical analysis of main-stream depictions of the concepts of leadership (Elstrup Rasmussen, 1996) combined with the problem that it is not possible, within the theory of discontinuity, to directly determine how forms of sense-making are co-ordinated. The theory of discontinuity includes no functional models for the interaction of forms of sense-making in the form of leadership, but in Elstrup Rasmussen (1996) the idea was developed that leadership might be a form of co-ordinating co-operation, as described by Kugler and Turvey (1987), and it is this idea which is expanded upon theoretically in the present work.

The theory of discontinuity (Elstrup Rasmussen, 1994b) describes in basic terms how flows of information are handled mentally by emerging structures which are analysed as catastrophes. The theory of discontinuity thus assumes the existence of information flows. However, the overwhelmingly structurally oriented theory includes no analysis of how information flows give rise to the emergence of cognitive structures. Since it is a prerequisite for being able to utilise the models developed by Kugler and Turvey that the theory of discontinuity include structural emergence described in thermodynamic terms, it has been necessary to transform the theory so that it is directly comprehensible within a thermodynamic frame of reference. Such a transformation is possible because thermodynamics as a method is *independent* of any sort of theory of material or interaction mechanisms. In the process of transformation the strategy has been to apply Kugler and Turvey's (1987) biophysical form of thought as a theoretical boot-strap. Perspective Text Analysis, which has already been developed within a thermodynamic framework, has in its theoretical form functioned as a catalyst in the transformation process referred to. Perspective Text Analysis has at the same time as a method made it possible to empirically contextualise the functional concept of leadership in the form of mental models.

The fundamental procedure in the theoretical work has been to show that biophysically determined organising principles can themselves be transformed by the theory of discontinuity to a modern form of ecological psychophysics, which is in a position to include a functional concept of leadership. The basic theoretical work has thus been directed towards transforming a biological frame of reference to a psychological one in such a way that it has been possible to maintain a set of organising principles through this transformation.

The most important organising principle which has been invariantly transformed from the biological to the psychological level can be described as a limit-cyclical self-writing/self-reading process. It has been shown that this natural principle, which in its paradigmatic form (int(A)) a (ort(O)) (B. Bierschenk, 1984) includes an intentionally (int) oriented (ort) linking of activity (a) between an agent (A) and an objective (O), by virtue of the self-referential form of mental systems, means that mental systems are not only information guided but are also information handling. Mental systems can, through natural language, which collects information in the form of ideas, deviate from their own self-generated minimum trajectories. Humans can generate stable, idea-determined systematisms, as analysed in Elstrup Rasmussen (1994b) and transform them by making sense through the use of natural language, as described by Bierschenk (1993b). Language-borne ideas are a type of second-order information. Whereas the concept of information is bound up with direct perception, the concept of idea is bound up with the processing of information. We could say that information is an abstraction of the complicated ecology, while ideas are abstractions of the complexity which ecology itself comprises as an information flow. The result of the analysis has thus been that guidance of human activity in complex flows of information can be described as self-referential, self-assembling auto-oscillation, which makes the unknown known by making sense through the production of natural language. This special form of organisation has been designated as competence. The mental expression of competence: the holophor, can with the help of Perspective Text Analysis be described topologically as a cohesive set of stable attractors which include information in the form of ideas.

And it is this very co-ordination of the holophors created by competence which comprises the basis for understanding the concept of leadership. The idea behind the concept of leadership is bound up with the organising principle which implies that two auto-oscillating systems which are linked together will function as one virtual system. Through a theoretical analysis it has been shown how this organising principle can be transformed invariantly from the biological to the psychological level in such a way that the competence linking of mental systems can be described as the co-ordination of single holophors to virtual superholophors. This co-ordinating process itself, i.e. the co-ordinating co-operation, can be regarded as an innovative seeking process, which is directed towards establishing a stable state: the superholophor, which satisfies both auto-

oscillating systems and which is naturally altered by this same process. On the basis of the theory created a number of hypotheses can be derived concerning the functional nature of leadership. The concept of leadership established in the present work differs from main-stream descriptions of leadership by being theoretically rooted and operationally applicable, as a result of which it can serve as the frame of reference for experiments. Such experiments are in the planning stages.

In order to contextualise the concept of leadership a limited empirical investigation was undertaken of co-operation between two students, who wrote a joint BA thesis in the spring of 1996. The two students were asked, before commencing their co-operation, to describe their expectations of the co-operation, which they subsequently were also asked to describe. The theory of leadership would be supported if it could be shown that the mental picture of one of the partner's expectations of future co-operation appears in the other's mental picture of the actual co-operation and vice versa. The empirical investigation does support the proposed theory, as it can be shown that the expectation holophor of one partner is embedded in the other's mental co-operation holophor and vice versa. A clear crossing over has taken place, just as it should in the event that the two mental systems have been embedded in co-ordinating co-operation.

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